EFFECT OF RUNNING IN WINTER AND SUMMER ON BODY FAT AND ENDURANCE OF WOMEN ATHLETES

A
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SUBMITTED THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN
PHYSICAL EDUCATION
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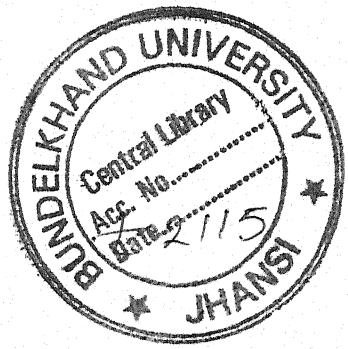

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CERTIFICATE

This is to certify that the work entitled "EFFECT OF RUNNING IN WINTER AND SUMMER ON BODY FAT AND ENDURANCE OF WOMEN ATHLETES" is a piece of research work done by Ms. Neeta under my guidance and supervision for the degree of Doctor of Philosophy in Physical Education, M.D.I.P.E.S., Bundelkhand University, Jhansi (U.P.), India. That the candidate has put in an attendance of more than 200 days with me.

To the best of my knowledge and belief the thesis :

1. Embodies the work of the candidate himself.
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3. is up to the standard both in respect of contents and language for being referred to the examiner.

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DECLARATION BY THE CANDIDATE

I declare that the thesis entitled "EFFECT OF RUNNING IN WINTER AND SUMMER ON BODY FAT AND ENDURANCE OF WOMEN ATHLETES" is my own work conducted under the supervision of Dr. Abhay Kumar Srivastva, Director, Physical Education, Delhi College of Engineering, Delhi-110042, approved by Research Degree Committee. I have put in more than 200 days of attendance with the supervisor.

I further declare that to the best of my knowledge that the thesis does not contain any part of my work, which has been submitted for the award of any degree either in this University or in any other university without proper citation.

Signature of Supervisor Signature of the Candidate

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ABBREVIATIONS

d	=	Difference
$\bar{d}$	=	Difference of Mean
S	=	Standard Deviation
X	=	Initial Test Score
Y	=	Final test Score
R.Q.	=	Research Quarterly
P.P.	=	Pages
Vol.	=	Volume
No.	=	Number
fig.	=	Figure
figs.	=	Figures
h.r.	=	heart rate
min.	=	minute
hr.	=	hour
et.al.	=	and others
mts.	=	metres
pWC	=	Physical Working Capital
FVC	=	Force Vital Capacity
HPER	=	Health physical education and Recreation
C.R.	=	Cardio-respiratory
PEI	=	Physical Efficiency Index

EFFECT OF RUNNING IN WINTER AND SUMMER ON BODY FAT AND ENDURANCE OF WOMEN ATHLETES

CHAPTER-I

CHAPTER-I

INTRODUCTION

General education is concerned with develop a good life for all people. It seeks to prepare an individual for purposeful and meaningful life as a member of families and organizations and as future citizen. Today general education is looks as preparing individual for a meaningful, self directed existence.

John Dewey[1], an Educator who has most profoundly influenced education, defined education as the reconstructions of events that compose the lives of individuals so that new happenings and new events become more purposeful and meaningful. Furthermore, as a result of education individuals will be better able to regulate the direction of ensuing experience.

"Physical Education is a part of general education, its emphasis on building physically, emotionally, menta and socially fit of an individual."[2] Thus, physical education contributes to knowledge of exercises, health and health and diseases under cognitive domain of an education.

The educated person should have an understanding of the facts pertained to exercise, health and disease. To a

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[1]*Charles A. Bucher, Fundation of Physical Education and Sports. New York : Times Mirror Mosby College Publishing, 1987, p. 57.*

[2]*Ibid.*

degree, an individual's success depends on personal health. Physical education can contribute to this knowledge by instructing individuals about their bodies and movement and importance of nutrition, physical activities, rest and sleep; by informing them by exploring the preventive and control measures that exist to guard against diseases; by providing opportunities for vigorous outdoor activity; and by establishing various health services.

Physical education is a body oriented discipline and there has been keen awareness of need of physical fitness. Due to increased automation and mechanization physical activity has been greatly reduced and diseases like hyper tension, depression, obesity, asthma, cardiac trouble etc. has been created. Therefore level of physical fitness seems to have gone down considerably. Hence the need of such measures which would not only relieve the people from health problems but also help to increase the level of fitness to work efficiently.

Fundamental success in education or any fact of living for that matter is good health, and this cannot be achieved in youth unless growth and development take place in an acceptable manner. Under any hypothesis, a sound fit body is essential for an individual to achieve his full educational potential. Fitness plays an important role in all aspects of health. "Health and fitness are inexorably related. Good health provides a solid foundation for fitness and fitness provides one of the most important key of health.[3]

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[3]*Harold M. Barrow, Man and His Movement. Philadelphia : Lea & Febiger, 1973, p. 146.*

Good health is more than simply freedom from disease. It is dynamic condition of high level wellness. As has been stated by the W.H.O., health is "state of complete physical, mental and social well being not merely the absence of disease or infirmity."[4]

Health is the ability of an individual to mobilize the resources physical, mental, and spiritual, to the preservation and advantage of himself, his dependents and the society to which he belongs.[5]

It is evidenced that the physical fitness has been one of the essential requirements to maintain the health and to develop the personality. Hence the people have become much more dependent on medical drugs for alleviating themselves from diseases and the disorders. It seems, they are losing positive side of their health. Their efforts are limited only to the point of protecting themselves from diseases. Therefore, there is an urgent need to educate the people regarding positive side of their health and value of health physical fitness.

Joseph W. spent many years in studying human physical and intellectual behaviour. He found out the physical development of people today to be lacking; therefore, the physical education must help to develop a higher and better plan of living. To complete this task in the programme of physical education activities that are utilized today have as a

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[4]*Reuben B. Frost, Physical Education Practices Principles. Londos : Addison Wesley Publishing Company, 1975, p. 304*

[5]*Thomas Reilly, Sports Fitness and Sports Injuries. London and Boston : Faber and Faber, 1981, p. 23.*

basic activities for example : running, throwing, jumping, hopping, stretching and swimming. These activities will best serve the purpose of developing body with a strong framework and adequate mechanism and "there is considerable evidence that for most adults and youths regular participation in vigorous daily exercise is of value in keeping the body weight within the normal range for developing endurance."[6]

"The higher the percentage of fat body weight, higher the percentage of obesity".[7] Excess fat on the body, commonly referred to as obesity, is the problem that concerns all individuals; to remove this problem, the criteria of treatment should followed by the professional personnel i.e. loss of weight to the level. Obesity is not only unattractive but also a serious health hazard. It increases susceptibility to number of diseases and disorders.[8]

The loss of weight to the level may help to develop the cardiorespiratory endurance which is basic component of physical fitness. This form of endurance is characterized by moderate contractions of muscles for large period of time, during which maximum adjustment of the circulatory respiratory system are necessary, as in sustained running, climbing, swimming and like.

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[6]*D.R. Casady and D. F. Mapes, Handbook of Physical Fitness Activities. New York : The Macmillan company 1965, p. 19.*

[7]*F.M. Verducci, Measurement Concept in physical Education. St. Louis : The C.V. Mosby Company, 1980, p. 221.*

[8]*H. Clarke, Application of Measurement to Health and Physical Education. Englewood Cliffs; N. J. : Prentice Hall, Inc., 1976, p. 152*

With all above statement and explanation, the atmospheric conditions and water temperature may affect the endurance. Modern researches reveal several facts about the inclement weather specially the hot one, and its bad effect on the athlete. High humidity with high temperature creates problem of body heat dissipation. The normal comfortable humidity is generally considered 40 to 70%.

Physical educators and investigators have long been concerned with the measurement of cardio-respiratory endurance. The early approaches were made by medical pioneers in physical activities as preventive medicine. Currently interest is high on the use of cardiorespiratory elements in the evaluation of cardiorespiratory endurance. Many physical educators, scientists are trying to intercet the sophisticated processes.

By considering all above evidence regarding the effect of running, Researcher had undertaken the subject for the study to see the seasonal effect of running on the body fat as well as on cardio-respiratory endurance. Through this study researcher has tried his level best to bring forward the conclusions. Researcher expects that these conclusions will certainly contribute to explore the methods, with reference to seasons for developing endurance and to maintain the required body fat for betterment of health and even the development of endurance.

1. Statement of the Problem :

The researcher had come across the past evidences about the effects of running on different variables of physical fitness as well as the body fat, through literature published in the sports Bulletins and Research volumes.

Many times it was observed by the researcher hind there was a effect of seasonal running on physiological parameters and body fat. To support the statement of the problem the researcher has brought forward the literary evidences as follows :

John Troup[9] has recommended in his article ; "Running for Fitness", that the running more than any other sports, develop cardiovascular endurance. Additionally the danger of injury is minimized since the force of gravity does not play a major role due to buoyant effect of water.

The ancient text on Ayurveda i.e. the Indian system of medicine talk of "fluctuation of natural strength of the body due to change in season". According to these texts, bodily exercises is indicated during winter season and contradicted by Ayurved during summer season.[10]

Therefore the researcher had undertaken the present problem; "**EFFECT OF RUNNING IN WINTER AND SUMMER ON BODY FAT AND ENDURANCE OF WOMEN ATHLETES.**"

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[9] *John Troup, "Running for Fitnesss", Bulletin of Sports and Medicine. Vol. VI, No. 1, Jan. 1973, p.28.*

[10] *S. H. Deshpande and Tarzen, K., "Effect of seasonal variation on performance level", Bulletin of Sports Medicine, Vol. 4, Oct. 1983, p. 10.*

2. Significance of the Study

The main interest of the researcher behind this study was to see the seasonal effect (summer and winter) on body fat and endurance of women athletes ranged between 17 to 20 years.

Following were the attributes of the significance of study:

1. The study would bring forward the merits and demerits of season.
2. The study would enable the coaches and amateurs to adopt season to develop endurance and to reduce and increase body fat.
3. It would make available a new field of research for further study.
4. It might also provide guideline to competitors to develop the fitness and performance.
5. The study would help to know the role of the temperature.

3. Objectives of the Study :

The objectives of the study were as follows :

1. To find out the effective season to increase and reduce the body fat.
2. To find out the place of training schedule and temperature to improve the endurance.
3. To find out the effective season for endurance development.

4. Hypothesis :

In general concept, running is always recommended to maintain the health and improve the general fitness endurance, which is important component of it. Therefore, the researcher had undertaken the present work and hypothesised that the running in winter increases fat and improves the endurance, as compared to summer.

5. Delimitations of the Study :

The scope of the present study was delimited on the following points :

1. The study was delimited to the female subjects between 17 to 20 years of age.
2. The study was restricted to the following variables of body fat and physical fitness :

   (i) a. Bicep fat
   b. Tricep fat
   c. Subscapular fat
   d. Suprailiac

   (ii) Cardiorespiratory endurance an important component of physical fitness.
3. The training schedule of running consisted of running a distance, training repetitions for various distance.
4. The training was carried out in the Track.
5. During the training climatic temperature were recorded.

6. Limitations of the Study :

The study was limited to the following :

1. The female subjects who were kept on experiment belonged to different localities.
2. There was no control over the extra-curricular activities of the subjects.
3. There was no control over the diet of the subjects.
4. There was only the observation of climatic conditions and nutrition.
5. No attempts were made to motivate the subjects while varies measurements were taken for conducting the test.

7. Definitions of the Terms :

Body fat **:** Body fat is the most variable tissue in the body and is distributed throughout in the abdominal cavity.[11]

Skinfold Caliper **:** The Skinfold Caliper gives us thickness for estimation of total body fat, inasmuch as fifty percent of total body fat lies immediately under skill.[12]

Endurance **:** The ability to resist include muscular endurance which is local or specific endurance and cardiovascular endurance which resists fatigue and helps quick recovery after fatigue.[13]

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[11] *Z.F. Earle, Physical Educationand Sports An Introduction. Philadelphia : Lea & Febiger, 1982, p. 79.*

[12] *D.K. Mathew, Measuremetn in Physical Education. London : W. B. Saunder Company, 1973, p. 287.*

[13] *H. Wilmore, Athletic Trainign and Physical Fitness. Englewood Cliffs, New Jersey : Ronald Publishing Company, 1978, p. 250.*

Body Composition *:* Body composition is a proportion of the lean body mass and depot fat.[14]

Subscaupla *:* The measurement is made at the bottom of the shoulder blade (the scapula).

Supra-iliac *:* The measurement is made just above the top of hip bone (crest of the ilium) at the middle side of the body.

Triceps *:* The measurement is made at the back of the upper arm midway between the shoulder and elbow joints.

Biceps *:* The measurement is taken, of the skinfold on front of the upper arm.

Cardio-respiratory Endurance : Cardio-respiratory endurance is a basic component of physical fitness. This form of endurance is characterized by moderate contractions of large muscle groups for relatively long period of time, during which maximum adjustments of the cardiorespiratory system are necessary, as in sustained running, swimming, climbing, bicycling and like. This physical fitness component is very complex. The elements of the C-R system affected include the heart and lungs, the vessels supplying blood to all parts, and the capillary network receiving the blood. Other body systems are also affected by endurance exercise.

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[14]*Hodder & Stoughton, Health Related Fitness. London, Sydney, Auchland, Toronto ;*

CHAPTER-II
REVIEW OF LITRATURE

CHAPTER-II
REVIEW OF LITRATURE

A few studies have been reviewed hereunder, which have been conducted by different researchers at various places. They are related with the body fat and cardiorespiratory endurance.

Areawise reviews are as Under :

Body Fat and Skinfold :

Bruce and Robert[1] carried out an investigation on "changes in body composition and physique of elite university level female runners during competitive season".

Changes in the body composition of a sample of elite university level female runners were mentioned at three part during a competitive season, October, December and March. Body composition was estimated via desitomentry and a series of anthropometric dimensions was taken at each occasion. Body weight, absolute and relative fitness, all six skinfolds and calf circumference decrease, while density and lean body mass increased significantly during the period of intensive training between October and December. Changes during the second half of the season were smaller' weight and relative fitness increased, while body density and triceps skinfold decreased

[1]*B.W. Melski and Maline R.M., "Changes in Body Composition and Physique of elite university level female runner during a competitive season". Journal of sports Schiece, Vol. 3, No. 1, 1985, p. 33.*

significantly between December and March. Hence the major changes in the body composition associated with running training occur during early part of the season when training was intensed.

Montoye and Reiff[2] studied the relationship physical activities to total serum chloestoral and skinfold fat in adult males.

In the above study the occupational and leisure physical activity records were collected by interviewing a 10% sample of adult males (N = 136) as part of the Tecumsch community Health Study. Energy expenditure table were developed for the activities and were used to determine total energy expenditure and fifteen sub-totals. Occupational energy expenditure for the last three months gave a good estimate of total annual activity. Physical activity had a little productive value for serum chloestoral, body weight or body fat.

Bowes[3] carried out an investigation of "the effect of specific exercise on selected skinfold and girth measures of college women".

For this study college women were divided into experimental group of twenty and control group of twenty four.

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[2]*J. Monotoye and Reiff G., The relationship of physical activities to total serum chloestoral and skinfold fat in in adult males". Completed Research in Health Physical Education and Recreation, Vol. 7, 1964, p. 70*

[3]*Barbara F. Bowes, "The effect of specific exercises on selected skinfold and girth measures of college women". Completed REsearch in Health Physical Education and REcreation, Vol. 10, 1968, p.84*

The experimental subjects participated in three, one hour classes per week for ten weeks. These classes consisted of thirty minutes of body mechanics and thirty minutes of modern dance techniques, composition and lectures with thirty minutes of specific exercises for the second five weeks. The control group attended no physical education classes. Girth and skinfold measurements were taken, and height and weight were recorded. There were no significant differences between groups in the measures analysed. There were several significant differences within group changes, more in the experimental than in the control group and more evident during the fifth to the tenth week comparison.

Novak[4] conducted the research on the effect of various sports on body composition.

The subjects for this study were twenty-six varsity runners from two senior high schools. The first testing was accomplished in October, before swimming season began and post-testing was done at the end of March of the following year. The training programme included two hours continuous running per day for five days a week. Saturday competition included participation of each runner in two or three events. Physical measurements included height, weight, respiratory rate, blood pressure and pulse rate.

The statistical analysis was done and found that the adolescent runners benefitted from five months of vigorous competitive running programme in gaining total body cell mass

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[4]*Ladislave P. Novak, "Effect of competitive running body compsition of Adolescent Boys". Bulletin of Sports Medicine, Vol. V, April & July, 1983, No. 2-3, p. 23.*

and particular evidence of greater muscular mass was observable from significant increase in certain in excretion further lean body mass was enhanced while simultaneous decrease in total body fat was observed.

Samual and Toriola[5] found out the effect of different running programmes on body fat and blood pressure in school boys aged 13-17 years.

This study assessed comparatively the effects of eight weeks continuous and interval jogging on percent body fat and blood pressure in fifty-five untrained Nigerian school boys whose mean age was sixteen years. The subjects were categorised into a control group of eighteen, a continuous running group of eighteen and interval running group of nineteen. Relative body fat was determined with large skinfold caliper. Subjects within the continuous running group jogged 4.8 km, three times a week for eight weeks at 8--85% of their maximum heart rate. The control group had no exercise regimens. The statistical analysis were done and found the exercise group had significantly reduced percent body fat.

Effect of Warm-up, Different Training Programmes on running and runner :

Veries[6] has made a research on the effect of various warm-up procedures on 100-yard times of competitive swimmers. It is found that the group as a whole showed

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[5]*S.A. Adeniran and Toriola A.L., "Study of the effect of different Running programmes on Body fat and Blood pressure in school boys aged 13-17 years". The Journal of Sports Medicine and Physical fitness, Wol. 28, No. 3 p. 267.*

[6]*Herbert A. De Veries, "Effect of various warm up on 100 yard Times of competitive Running". Research Quarterly, Vol. 30, No. 1, March, 1959, p. 11.*

significant improvement only following the swimming warm-up, whereas the breast-stroke and dolphin swimmers as a group had their best and significant improvement following calisthenics. The free stylers as a group showed a significant decrease in speed in their trials after calisthenics warm-up.

Key[7] has made a research on the effect of load running endurance in human. He has selected twenty male subjects between ages of seventeen and twenty four, who swam in vertical to semivertical position until exhausted or hour had elapsed. This was done with loads of 0, 2, 4, 6, 8, 10, 15, 20, 25 and 30 percent of the body weight. The load used as a weight placed around the waist of the swimmer. The times were recorded, each load and mean determined and plotted. The relationship between load and endurance was close and curvilinear. Heavier individuals were at a slight disadvantage in this running test which used percentage of body weight, as body weight did not decrease running time appreciably, while load of thirty percent reduced running time to matter of seconds.

Lavoie et al.[8] made a study on "physiological effect os training in elite runners as measured by a free running test.

For this study eleven Canadian national swimmers, six males and five females; and fourteen college age recreational swimmers six males and eight females, were selected. The

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[7]*L.T. John R. Key, "Relationship between load and swimming endurance in human". Research Quarterly, Vol. 33, No. 1, March 1962, p. 559.*

[8]*J. Lavoie, A. W. Taylor and Montpetit R. R., "Physiological effects of training in elite swimmers as measured by a free swimming Test". Journal of Sports Medicine and Physical Fitness, Vol. 21, No. 1, March 1981, p. 38-42.*

slite swimmers were tested before and after sixth month training period. The pre-training data were acquired at the beginning of the training season and the regular training programme included weight-lifting and two swim season daily, six days per week. The daily swimming distance was progressively increased from 8000 to 18000 meters during the six month period. The recreational swimmers were evaluated once using the same test as the elite group.

The training response of element Canadian national swimmers was investigated. These swimmers were tested before and after six month training period for :

i) maximal aerobic power (VO_2 max), ii) maximum heart rate, and iii) blood lactated concentrations, using free swimming test. VO_2 max increased from 4.11 to 4.441/min. (p 0.02; 8% increase) and from 3.15 to 3.371/min. (p 0.05; 7% increase) for male and female group respectively.

Maximal heart rate decreased significantly. For 100th group of swimmers. It was concluded that cardio-vascular adaptations can occur in elite athletes submitted to a severe training programme.

Marine[9] conducted the study on age trend in heart rate values during and after submacimal work in women 30-50 years old.

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[9]*E. Marine, "Age trends in Heart rate values during and after submaximal work in women 30-50 years old". Completed Research. T. Ab. 206, Vol. 7, 1965, p. 69.*

In this work height, weight and public skinfold measurements were taken on 10 women volunteers in each five years age group from thirty to fifty. Heart rate were recorded before, during 8 minutes, after 3 minutes step test at 24/min on 8 inch bench. Level of activity was estimated in four categories from light to very active on the basis of questionnaire. Four fifth of the subjects were under standard weight. Weight percent fat and fat free body weight were greatest in the 35-40 years group and progressively less in the two older groups. The youngest group had the fastest heart response to exercise and the most rapid recovery, but maximum heart rate during exercise showed no distinct age trend and no clear relationship to activity level. The correlation between maximum heart rate and weight was 214. Body weight and fat free body weight were highly correlated and subjects with the lowest fat free body weight had the fastest heart recovery rate.

Scott[10] conducted the study on the effect of isometric and elastic cord exercises on strength and speed of running.

In this study male college students in two advanced runners and one life-saving class (N = 51) were randomly assigned to three groups. The two experimental groups undertook the regimen of functional isometric and elastic cord exercises, coupled with regular instructions. Pretest analysis

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[10] *Jimmin Dan Scott, "The effect of isometric and elastic cord exercises on strength and speed of running". T. Ab. 332, Vo. 10, 1968, p. 56.*

showed no difference in strength and running speed among groups weekly testing in the first six weeks, using analysis of variance and Tukey's contrast for multiple comparison, yielded evidence that all groups gained significantly in strength; the exercise group by the end of the second week, gained in running speed over the control, with no significant difference between strength gained by functional isometric and by elastic cord exercises. Strength gained was maintained as well by elastic cord exercise performed by every 2 weeks as once a week.

Training Effects on Physical Fitness and Cardio-respiratory Endurance :

Chen-Yu[11] has seen the effects of Aerobic dancing on cardio-respiratory function, body fat and body composition in women.

Under investigation, eleven average thirty seven age female were performed a forty five minute aerobic dancing programme three days per week for ten weeks. After training significant decrease were found in percent body fat ($p > .001$), though there was no significant change in total body weight ($P < .05$). Changes in blood pressure were not sure yet ($P > .05$); while resting heart rate and twelve minute run had significantly been improved, the content of triglyceride and cholesterol in total lipids appeared significant decrease ($P > .01$ and $P < .05$ respectively).

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[11]*Chen-yu-ying, "Study on effect of aerobic dancing on cardio respiratory function, body fat, and body composition in women. Ichper Asian Journal Quarterly of Physical Education Vo. 10, No. 4, Jan, 1988, p. 73.*

The result prove that aerobic dancing is worth to expand for public which can definitely make positive effects for public which can definitely make positive effects on the improvement of cardio-respiratory function, the changes of body composition, and the decrease of blood lipids.

Curdy and Larson[12] compared the cardiorespiratory measure of three different groups of sixty Springfield varsity swimmers 138 infirmary patients with respiratory infections and forty American national swimmers in peak condition.

The result showed that American American National swimmers in peak condition has the highest vital capacity and Springfield varsity swimmers come next. The group of infirmary patients had comparatively lower vital capacity which suggested that the physical condition achieved by training was the cause of increased vital capacity.

Jackson[13] studied the effect of various training frequencies on cardiorespiratory endurance.

Under this twenty men were pretested for maximal oxygen intake, given the Balke treadmill test, and had their aerobic capacity predicted within the Astrand Ryhming equation. The predicted aerobic capacity correlated significantly with the other two test results but the Balke maximum oxygen intake result were not significantly related. The subjects were

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[12]*McCurdy and Larson, "The validity of circulo-respiratory measures in an index of endurance condition in swimmers" R.Q., Oct. 1940, p. 3-11.*

[13]*J.H. Jackson, "The effect of various training frequencies on cardiorespiratory endurance". Completed Research in H.P.E.R., Vol., 9, T.Ab. 293, 1967, p. 8*

assigned randomly to group training 0, 1, 2, 3, or 5 days/week on the treadmill at progressive grade for five weeks \before resting. Maximum oxygen intake was not significantly increased but the results of the other two tests showed improvement.

Guatschi et al.[14] have seen the effects of specialised training on physical fitness of university competitive swimmers.

In this study male members of the University of British Columbia Varsity Swimming team consisting of twelve were given various fitness tests at the beginning, middle, and end of a six month competitive season. Training consisted of four hour per week in the water plus a systematic dryland exercise programme. The swimmer engaged in general circuit training for one month, interval circuit training for 2.5 months and a swimming training circuit for the final 2.5 months. The fitness test consisted of dynamometrical strength in terms, chin dipsvertical jump, vital capacity, vertical jump reaction time, anklw flexibility and the Harvard step test. The only mean improvement observed were in chins, dips, reaction time and ankle flexibility items and most of the improvement occurred in the first half of the season. All swimmers improved upon their former best times in competition.

Field[15], studied the anatomical and physiological differences between three groups of swimmers of varying abilities.

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[14]*Gautschi and Edwin H.M., "The effect of specialization training on fitness of university competitive swimmers". Completed Research in H.P.E.R., Vo., 9, T.Ab, 26, 1967, p.43*

[15]*John Bloom Field, "Anatomical and physiological differences between three groups of summer of varying abilities", Completed Research in HG.P.E.R. Vol., T. Ab. 424, 1967, p.77.*

In this study subjects were 120 senior level swimmer who were divided into three ability groups on the basis of two criteria of the mean from thirty nine tests administered in the study, only in three of the comparisons did the mean of the national level group significantly surpass those of the high level university swimmers. In contreas the means of the national level groups were significantly higher than those of the low level university swimmer in fourteen test.

Williams et al.[16] studied the changes in selected cardio-respiratory responses to exercise.

In this study cardio-respiratory and body composition changes were evaluated in twenty five sedentary females, aged eighteen to thirtyfive years, following twelve weeks of aerobic dance training (3 days a week, 45 minutes a session). Fifteen subjects, the same population, comprised a control group. The aerobic dance training programme produced effects in the experimental group. These training effects were indicated by significant improvements in 02 pulse, V heart rate perceived exertion during submaximal exercise.

At last it was concluded that these twelve week aerobic dance programme was successful in promoting beneficial changes in cardio-respiratory fitness and body composition. No significant improvements in any of these variable were found for the control group.

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[16]*Lexie D. Willian and Mortan A.R., "Changes in selected cardio-respiratory responses to exercise". Journal of Sports Medicine, Vol. 4, No. 3, Winter, 1986, p. 289.*

Effect of Training on Different Aspects :

Zauner and Benson[17] conducted the study on physiological alterations in bound running during three years of intensive training.

For this study seven females and eight males age group ranging from 9-19 years were selected. Each subject, even the youngest, had at least 50% of life invested in competitive swim training, thus creating prejudice against finding physiological improvement attributable to subsequent training. These athletes trained in swimming by means of twice daily practice sessions each totalling from 6000 to 10,000 metres. The winter training programme brought swimmers to the practice pool at least six times weekly with long yardage and weight training as features. In an effort to examine the effects of prolonged intensive training upon children, seven females and eight males successful young competitive swimmers active in a twelve month training programme were measured for maximum oxygen uptake (VO_2 max). Physical working capacity forced vital capacity and for body surface area.

An outcome of training young runners showed progressive increase in VO_2 max. and PWC which are independent of growth. The FVC may be increased beyond expectations through prolonged training in childhood.

Faulkner et al.[18] studied the pulse rate after 50 metres running.

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[17]*C.W. Zauner and Benson N.Y., "Physiological alterations in yound swimmers during three year of intensive trainig". Journal of sports Medicine and Physical Fitness, Vol. 21, No. 2, March 1981, p. 179-183.*

[18]*John A. Faulkner and Dawson R. M., "Pulse rate after 50 mts swim". R.O., Vo. 37, No. 2, May, 1966, p. 282.*

Nineteen girls between twelve to nineteen years of age were selected. These subjects swam fifty metres from a push of at 25, 50, 75 and 100 percent of maximum speed. Temperature was nineteen degree C and air temperature was twenty five degree C.

Throughout the velocities studied, the relationship between swimming velocity and heart rate was reasonably linear in the front crawl, back and breast stroke. The relationship in the butterfly stroke was more curvilinear. However, fewer data were available and swimmers in this stroke were less skilled. Undoubtedly a curvilinear relationship would develop at extreme velocities over a fifty mts. distance in all the strokes. An asymtote in velocity with increasing heart rate was observed in PB and RC in the back stroke.

Louise[19] investigated the effect of supplementary exercises with running and gold on selected physiological factors of college women. The test was conducted follows :

The Roger's PEI and a cardiovascular efficiency test for girls and women were administered to ninety-six college women in physical education basic skill courses at the beginning and end of eight weeks of either beginning gold or intermediate running combined with or lacking added isometric exercises. Analysis of covariance and 't' test indicated that all

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[19]*Mary Loise, "The effect of supplementary Isometric exercises with running and gold on selected physiological factors of college women". Completed Research. Vol. 7, T. Ab. 195, 1965, p. 65.*

groups improved significantly in PEI and all groups improved in cardiovascular efficiency except the group which had gold alone. Supplementary isometric exercise was significantly superior to gold alone in developing cardiovascular efficiency.

Mowrer[20] undertook the study on some effect of a programme of distance running upon selected physical fitness measures.

For this college women were tested before and after eight week programme for breathing capacity with spirometer, abdominal strength with sit-up test, circulatory-respiratory efficiency with Harvard Step test, and body weight. During eight weeks, twenty two women swam twenty four quarter miles, sixteen participated regularly in an intermediate swimming class, and twenty one controls did not participate in physical activity programme. The distance swimmer improved significantly in breathing capacity and C-R efficiency. The intermediate swimming class improved significantly in all measures except weight and control group showed no significant improvement.

Higgins[21] studied the effect of running on physical fitness of college women.

In this study the Iowa test of motor fitness and power running test were given to nineteen intermediate runner and

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[20]*M.N. Jrare, "Some effect of a programme of distance running upon selected physical fitness measures". Completed Research in H.P.E.R. Vol. 6, 1964, p. 44.*

[21]*H. Lynne, "A study of the effect of running or physical fitness of college women". R.Q., Vol. 34, No. 2, 1963, p.45.*

thirty-five life saving students. The intermediate group shown significant improvement over the life saving group in arm strength and endurance, while the life saving group showed significant improvement over the intermediate group in abdominal strength and endurance. Little relationship was found between overall endurance, arm strength and leg power as measured in physical fitness and the swimming tests.

Nelson[22] investigated the effect of playing Basketball and running on three tests of explosive power (start and run, standing broad jump, and shot put). The experimental design accommodated eighteen subjects tested on five different non-activity days alternated with day of playing and swimming. The three tests were performed one hour following the activity. The standing broad jump and the shot put were significantly affected by the activity, whereas the start and run test was unaffected. The standing broad jump was best on nonactivity days and the shot put was on basketball days. Since jumping seems to be negatively affected by different land and water activity.

Carli et al.[23] has completed the study on the effect of running training on hormones level in girls.

The study was performed on nine (age 13 to 18 years) competitive girl runners with 2-5 years experience. All subjects

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[22]*Dale 0. Nelson, "Effect of running and basketball on various tests explosive power". R.Q. 33:581-87, Dec. 1962.*

[23]*G. Carli et al., "The effect of running training on hormones level in girls". The Journal of Sports Medicine and Physical Fitness", Vol. 23, No. 1, March, 1983, p. 45.*

were short distance competitors. Four girls had normal menstrual cycle during the previous season, while in the remaining girls menasche has not yet occurred, none of them were contracceptive users.

Blood samples were taken from nine teenage girl runners at interval of 4, 12 and 24 weeks during training. Training intensity and number of competitions gradually increased through season; cortisol and estradiol levels were modified by training but resumed initial values after twenty four weeks. At the end of season testosterone was found to be decreased, whereas ACTH and prolactin had increased.

Anderson and Donald[24] studied on the cardio-respiratory changes occurring in university freshmen males as measured by treadmill performance after ten weeks of participation in intermediate running classes.

In this study all subjects participated voluntarily and were free of cardiac impairments. The initial and final treadmill tests were at 3.4 mph and fourteen percent grade, 5.0 mph and eighteen percent grade, and 6.0 mph and twenty-two percent grade for three minutes or until exhaustion. Heart rate, block pressure, pulse pressure, ventilation, respiratory efficiency, oxygen consumption, oxygen pulse, duration and physical work capacity were measured. All measures showed statistically

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[24]*Anderson and Donald Thomas, "Cardio-respiratory changes occurring in university freshmen males as measured by Treadmill performance after ten weeks of participation in intermediate running classes". Completed REsearch Vol. 5, T. Ab. 301, 1963, p. 88.*

significant changes except respiratory efficiency. Duration and oxygen consumption were the most important variables determining total physical work capacity, determining the degree of physical fitness with respect to cardiorespiratory endurance.

Oldridge[25] studied on the recovery from the effect of running training as measured by the eosinophil count.

This study was make to determine the relationship between the changes in the eosinophil level and the stress levels of the running training schedule of males freshman runners at the university of Florida. Eosinophil counts were determined before and after a treadmill run on specific occasions throughout training. The difference between the Eosinophil counts was considered to be indicative of the training stress level. The eosinophil level was invariably related at the .01 level to the stress level resulting from the training schedule.

Hogan and Santomier[26] conducted the study on the effect of mastering running skills on older adults self efficacy.

The thirty-eight subjects were selected as volunteers, sixty years of age. Assignment to treatment or control group was dependent upon whether the days and time of five weeks

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[25]*Neil. B. Oldridge, "Recovery from the effects of running training as measured by teh eosinophil count". Completed REsearch, Vol, 9, T. Ab. 94, 1967, p. 52.*

[26]*P.I. Hogan and Santomier James P., "The effect of mastering running skills on older adult's self efficacy. R.Q., for Exercise and Sports, Vol. 55, No. 3, Sept., 1984, p. 294.*

swim lesson programme were convenient for the individual. Consequently eighteen subjects were assigned to treatment group and twenty for control group. The treatment group was given put face in water for five seconds; float on the front and back 10 sec.' swim the width of the pool; swim non-stop; 2 length of the pool programme for five weeks. Control group subjects were requested not to alter their life style during these five weeks.

Mean running self efficacy scores were determined of reach group for pretest, post test and change conditions. A one-way Anova (p. 05) using pretest to posttest running self efficacy change scores was used to determine if significant change is occurred. As expected, the treatment group (n = 18) had the larger change twenty in swim self efficient change is occurred. As expected, the treatment group (n = 18) had the larger change twenty in running self efficacy, and this change was found to be significantly different from the change for control group.

Joseph[27] investigated the effect of calisthenic, jogging and running on middle aged men.

Forty middle aged men were trained by caligenenic for ten weeks. At that time they were divided into running and jogging groups, and participated in their speciality for another seventeen weeks. Selected cardiorespiratory tests were given

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[27]*Joseph Jack j., "Effect of Calisthenics, Jogging and running on middle aged men". Journal of Sports Medicine and Physical Fitness, 14 (1974) : 19.*

before the programme began; after the ten weeks of running or jogging indicated no significant reduction in oxygen consumption during a standard submaximal treadmill walk; significant reduction in heart ratyes and an increase in the subject's oxygen pulse. It was concluded that there was no difference in the effect of jogging and running on the cardiorespiratory efficiency of the subjects, and that either activity could condition the cardio respiratory systems of middle aged men.

Effect of Temperature on

Cardio-respiratory Systems :

Toyoka and Kaneko[28] have investigated under three different room temperatures (TR) 10°C, 20°C and 30°C while relative humidity ranged 60-70% during the test period. The subjects were ten healthy male, ranged in age 19-22 years. All subjects were tested once at each room temperature (three experiments for one person) Under a fixed T(R) they took thirty minute rest and three minute warm up, then exercised on a bicycle ergometer. The work load was initiated by zero and increased by a step of 180 kgm/min upto exhaustion. The results were as follows :

i) The total work done, VOP V 2PV max. and VP VENPV max were not significantly different from T(R) to an other. Regarding the process of doing work,

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[28]*J. Toyoka and Kaneko M., "Effect of different room temperatures on cardio-respiratory response to maximal work". Research Journal of Physical Education, Vol. 17, No. 4, Jan., 1973, p. 205.*

ii) heart rates at 30°C were significantly higher than those observed at 20°C and 10°C during almost entire process of work.

Summery :

The Researcher has collected twenty eight reviews from different areas related to the body fat and cardio-respiratory endurance. The researchers who published their studies as above have given more stress on the effect of running on the different aspects of health, physical education and proved the importance of the study.

It is found from the about reviews that no one has attempted a study like the present one.

CHAPTER-III
METHODOLOGY AND PROCEDURE

CHAPTER-III
METHODOLOGY AND PROCEDURE

In this chapter the sources of data, selection of subjects, formation of groups, criterion measures, collection of data, procedure of administering the test, training schedule and statistical analysis are described.

1. Sources of Data :

The data for the present investigation were collected by administering the 'Harvard Test' For cardio-respiratory endurance and Body fat measurements were recorded with the help of Baker Mercer Steinfold calipers in millimeters. Under the Body fat measurements, the Biceps, triceps, subscapular and supra-iliac sites measurements were taken and compared against a ready reckoner prepared by During and Rehaman.[1]

2. Selection of the Subjects :

Hundred males swimmers were randomly selected as subjects to study ranged between 17 to 20 years age.

To ensure maximum cooperation from the subjects, the researcher had a meeting with the subjects. The purpose of the study were clearly explained to them in order to ensure that there should not be ambiguity among the subjects

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[1]*J.V.G.A., Durnin and M.M. Rahaman, "The Assessments of the Amount in the human body from measurements of skinfold Thickness". The British Jornal of Nutrition, 21, (1967) : 681-688.*

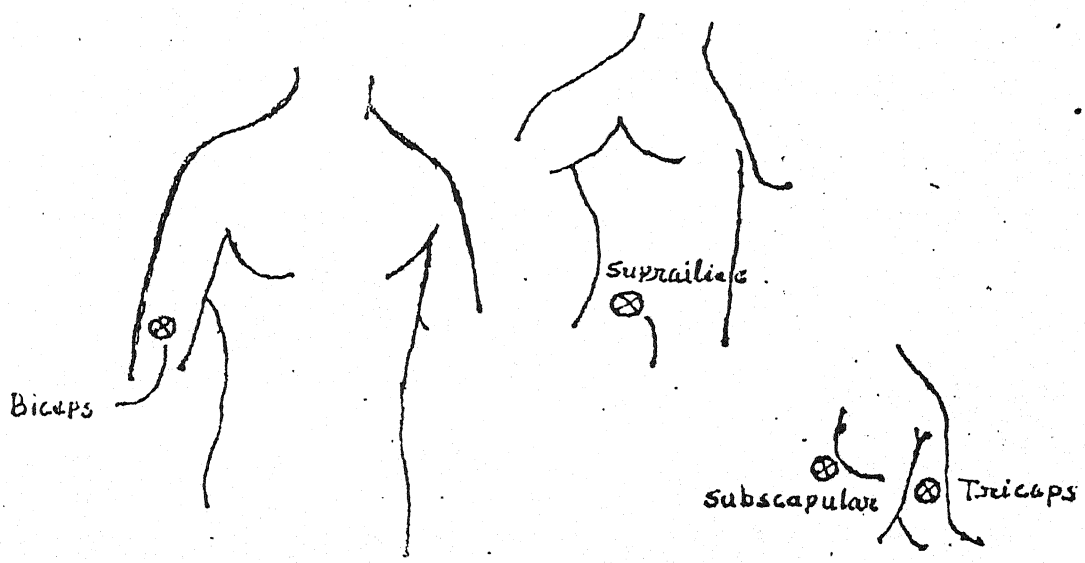

Fig. 1: Selected Sites of Skinfolds.

regarding the requirements and efforts they have to put in for the completion of this research work.

3. Formation of the Groups :

The selected subjects were divided into four equated group of one hundred each. Out of these four two were for winter an two for summer season. Out of these two the researcher made on experimental and another control group in each season.

4. Criterion Measures :

The selected variables for this study that influence the performance in the sports of running as is revealed from the review of professional literature and consultation with experts.

Keeping this in view the following variables were selected as they are directly related to the performance of runners.

1. Body Fat-Physical variable
2. Cardio-respiratory endurance : Physiological variable.

5. Collection of Data :

The necessary data was collected by administering the test and measurements chosen variables and by using the related equipments.

The subjects were given the change to practice the prescribed test, so that they might become familiar with the test and know exactly what was to be done. To ensure uniform testing conditions, the subjects were tested only during the evening session.

6. Administration of Test :

1) Body Fat :

Equipment : Skinfold callipers

Procedure :

To obtain the data of body fat of each subject, skinfold measurements were taken at four selection sites of the body namely, Biceps, Triceps, subscapular and suprascapular iliac, which is showing fig.1

The procedure of taking measurement are described below :

i) Biceps thickness was measured with the help of skinfold callipers, which is shown in figure -2.

The subject stood by extending the right arm at right side a little. The arm was in relaxed position. A double layer of skin and subcutaneous tissue was grasped with the thumbs and fore fingers of the left hand over the biceps muscles on the front of the subjects. The skinfold calliper was placed gently into the grasped skin without removing the fingers and the thickness of the skin was recorded from the indicator needle of the dial. It was measured to the nearest millimeter.

ii) Triceps thickness of the subjects was measured with the help of skinfold calliper which is shown in figure-3.

The subjects stood by extending left arm down and elbow extended in relaxed position. A double layer of skin was

grasped with the thumb and forefinger of the left hand over the triceps muscle on the back of the left arm, halfway between the acromion and elbow, where the skinfold runs parallel to the long axis of the arm. The skinfold calliper was placed gently into the grasped skin without removing the finger and thickness of the skin was recorded from the indicator needle of the dial. It was measured to the nearest millimeter.

iii) Subscapular thickness was measured by using skinfold callipers, which is shown in figure-4.

The subjects stood with shoulder chest but relaxed and arm by the sides. A double layer skin and subcutaneous tissue was grasped with the thumb and the force finger of the left hand lateral to the inferior angle of the right scapula, where the skinfold runs downward and outward in the direction of the ribs. The skinfold calliper was placed gently into the grasped skin without removing the finger. The thickens of the skin was recorded as indicated by the indicator needle of the dial. It was measured to the nearest millimeter.

iv) Suprailiac thickness was measured with the help of skinfold callipers which is shown if figure-5.

The subjects stood in a normal erect position and were instructed to draw a median breath and hold it, while in the same position. A double layer of skin and subcutaneous tissues were grasped with the thumb and force finger of the left hand in a position one to two inches above the right anterior

superior skinfold runs forward and slightly downward. The skinfold calliper was placed gently into the grasped skin without removing the finger and thickness of the skin was recorded from the indicator need of the dial. It was measured to the nearest millimetre.[2]

2) Cardio-Respiratory Endurance :

i) Harvad Step test[3].

The purpose of the test was to measure cardiorespiratory endurance of the subjects.

Equipments : Stop Watch, Metronome, A bench of 20 inches of height.

A) Description :

The subjects were asked to step up and down 30 times a minute on a bench which was 20 inches high. Each time the subject should step up on the bench with keeping the body erect. The stepping process was performed in four counts as follows. (Fig.6).

1. One foot placed on bench
2. Other foot placed on bench
3. One foot is placed on lower step
4. Other foot is place don lower step.

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[2]*Barry L. Johnson and J.K. Nelson, Practical measurements for evaluation in physical education. Delhi : Surjeet Publication, 1982, PP. 178-180.*

[3]*H.Harison Clarke, Application of measurements to Health and Physical Education. Englewood Cliffs, N.J. Prentice Hall Inc; 1987, PP 137-138.*

The testae my lead off with same foot each time or may change foot as a he desires, so long as the four counts step is maintained. The step may be times with metronome.

2. The subjects were asked to do the stepping exercise continuously for exactly five minutes, unless the subject is forced to stop sooner due to exhaustion. In either case, the duration of exercise in second is recorded.
3. Immediately after completing the exercise, the subjects were asked to sit on a chair. The pulse rate was counted 1 to $1\frac{1}{2}$, 2 to $2\frac{1}{2}$, and $3\frac{1}{2}$ minutes after stepping ceased.
4. A physical efficiency Index (PEI) were computed utilizing the following formula :

$$PEI = \frac{\text{duration of exercise in seconds} \times 100}{2 \times \text{sum of pulse counts in recovery}}$$

The following norms were used to measure the cardio-respiratory endurance. Norms are as follows :

Physical condition	**PEI**
Excellent	90 and above
Good	80 to 89
High average	65 to 79
Low average	55 to 64
Poor	54 and below

B) Reliability of Data :

The reliability of data was ensured by establishing the instrument reliability, tester competency and reliability of tests.

c) Instrument reliability :

The stop watches used for the study were received properly calibrated by the manufactures.

The skinfold callipers used for measuring skinfold of the subject was received calibrated by the manufactures.

Therefore all the instruments used for the study to measure the performance and skinfold measurement of the subjects on different variables were considered reliable for the collection of data.

d) Tester competency and reliability of the test :

The tester competency was evaluated together with reliability of the tests. The performance and skinfold measurement of the selected subjects at random on the selected variables were recorded twice under identical conditions by the scholar. A Person's product movement co-relation was computed between the two measures of each variable, and these reliability co-efficient are shown in table No. 1.

Table :1

Tests	Coefficient of reliability
Pulse count	.923
Biceps	.953
Triceps	.957
Subscapular	.947
Supra iliac	.951

N = 10

4.01(8) = .765 significant of

.01 level of confidence.

From the test, retest co-efficient of co-relation (Table-1), it was obvious that the tester reliability was significantly high at .01 level, establishing the competency of the scholar to administer the tests.

Records of water temperature :

Description :

To know the influence of water temperature on body fat-reduction and cardio-respiratory endurance development of the runners ranging between 17 to 20 years, the research scholar used to keep the record of running. The average temperature of the water in winter was 15°C, ranging from 12°C to 20°C and the average temperature was 35°C in summer season ranging from 30°C to 38°C.

This is shown with the graphical representation in figure-7.

Training Schedule :

The following treatment of training schedule were given for the experiment :

1) Strength and Flexibility exercises were given for 15 minutes which included calisthenics, circuit training, stretching exercises and jogging. The description of each is as under :

a) ***Calisthenics :*** Under the calisthenics the following exercises had been given with repetition. Exercises are

i) Neck rotation
ii) Shoulder Rotation
iii) Arm Rotation
iv) Swinging the arm side to side
v) Trunk Rotation
vi) Leg swinging to sides
vii) Leg swinging to forward and backward
viii) Jump and tuck
ix) Toe rotation.

Ten repetitions of each exercise were given to the subjects.

b) ***Circuit Training :*** Circuit training were administered one after the other with a prescribed recovery, which is taken after each circuit is completed.

As shown in the figure-7 the exercises were given one after the other.

i) Half squat

ii) Dips

iii) Sit-ups

iv) Lifting the upper and lower body from proune lying position

v) Burpee

The subjects were asked to do 15 repetitions with maximum possible speed for each exercise and three such circuit were given with active rest period of 1 minute.

c) ***Stretching :*** For flexibility the following exercises were given :

i) Bend and reach from standing position

ii) Side stretching

iii) Bend and reach from sitting position

iv) Stretching the shoulders.

The subjects were asked to do 10 repetitions of each exercise.

d) ***Jogging :*** The subjects were asked to do jogging two rounds around the track.

2) 800 mts. running as warming up.

3) 12 × 100 mts. : Slow interval training

After the warm-up the subjects were asked to perform 12 times 100 mts. with 60 seconds rest after each hundred.

4) 100 mts. : In this method of training for speed endurance development the subjects had to run at varying speed and to achieve the heart rate in between 140 to 150 minute.

The method was clearly explained by the researcher and convinced the subjects about its importance and the role of subjects in performing this method.

5) 300 mts. relax running ;

For the limbering down the subjects, researcher advised all for easy running, untill breathing returns to near normal and the pulse rate returns to 120 per minute.

All the four groups were given the dry land exercises to maintain their physical fitness and avoid the effect of land conditioning on the performance. Only Experimental group were going for running training 6 days per week for 6 weeks.

Statistical Procedure employed :

For testing the statistical significance of the difference between the group mean in physical and physiological variables of summer and winter groups (F ration) one way analysis of variable were employed.

In case of significant F values, the Scheffe's S post Hoc Test[5] was applied so as the determine the significance of variability in fat reduction and cardio-respiratory endurance as a result of administering six week training in winter and summer.

The level of significance was set at .05 level.

CHAPTER - IV

ANALYSIS AND INTERPRETATION OF DATA

CHAPTER - IV

ANALYSIS OF THE DATA AND RESULTS OF THE STUDY

The statistical analysis of the data collected on four hundred female runners with respect to selected criterion measures namely body fat and cardio-respiratory endurance, measured by skinfold caliper and Harvard Step test respectively are presented in this chapter. The data are furnished in appendix. The data were examined by one-way analysis of Variance[1] for the four groups to ascertain the change in body fat and cardio-respiratory endurance biweekly within the group for six weeks of training in running in summer and in winter season. When the differences were found to be significant by one-way analysis of variable, the Scheffe's 'S' Post Hoc Test[2] was applied to assess the significance of difference between paired means.

Body Fat :

Findings with regard to each of the criterion measures have been enumerated separately.

Body Fat Change (After Two Weeks) :

Findings pertaining to the changes in body fat after two weeks of training in running go both the two control and two experimental groups are given below.

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[1]*H. Harrison Clarke and David H. Clarke, Advance Statistics with Application to Physical Education. Englewood Cliffs, N.J.: Prentice Hall Inc., 1972, p. 14.*

[2]*H.A. Scheffe, "A Method of Judging All Possible Covecasts in the Analysis of Variance". Biometrica 4(1953) : 87.*

Table-1

One Way Analysis of Variable For the Data on Body Fat Changes of All The Four Groups After two Weeks of Training in Running

Sources of Variance	DF	SS	MSS	Obtained (F)	Required Fat.05 level
Between groups	3	13.5254	4.508	2.109@	2.704
Within	96	205.142	2.137		
N	=	100			

@Not significant at -.05 level of confidence.

An examination of Table-1, revealed that there was no significant difference in body fat changes after two weeks of training programme among the four selected groups at .05 level of confidence, as the F ratio of 2.109 obtained was lesser as compared to the required F .05 (3, 96) = 2.704.

Body Fat Changes (After Four Weeks of Training) :

One-way analysis of variance for the data on body fat changes after four weeks of training programme has been presented in Table-2, and the means of the four groups under two conditions of training have been depicted in Fig.2.

Table-2

One Way Analysis of Variable For the Data on Body Fat Changes of All The Four Groups After Four Weeks of Training Running

Sources of Variance	DF	SS	MSS	Obtained (F)	Required Fat .05 level
Between groups	3	50.1336	16.7112	9.593*	2.704
Within groups	96		1.672144		1.742

N = 100

*Significant at .05 level of confidence.

An examination of Table-2 revealed that there was a significant difference in body fat changes after four weeks of running programme among the four groups i.e. control group of summer season, experimental group (I) of summer, control group of winter season and experimental group (II) of winter, as the F ratio of 9.593 obtained was high as compared to the required F .05 (3,96) = 2.704.

Since the F ratio was significant Scheffe's 'S' Post Hoc Test was applied to test significance of differences between the paired means.

The mean and the difference between the paired means of body fat changes of all the four groups has been presented in Table-3.

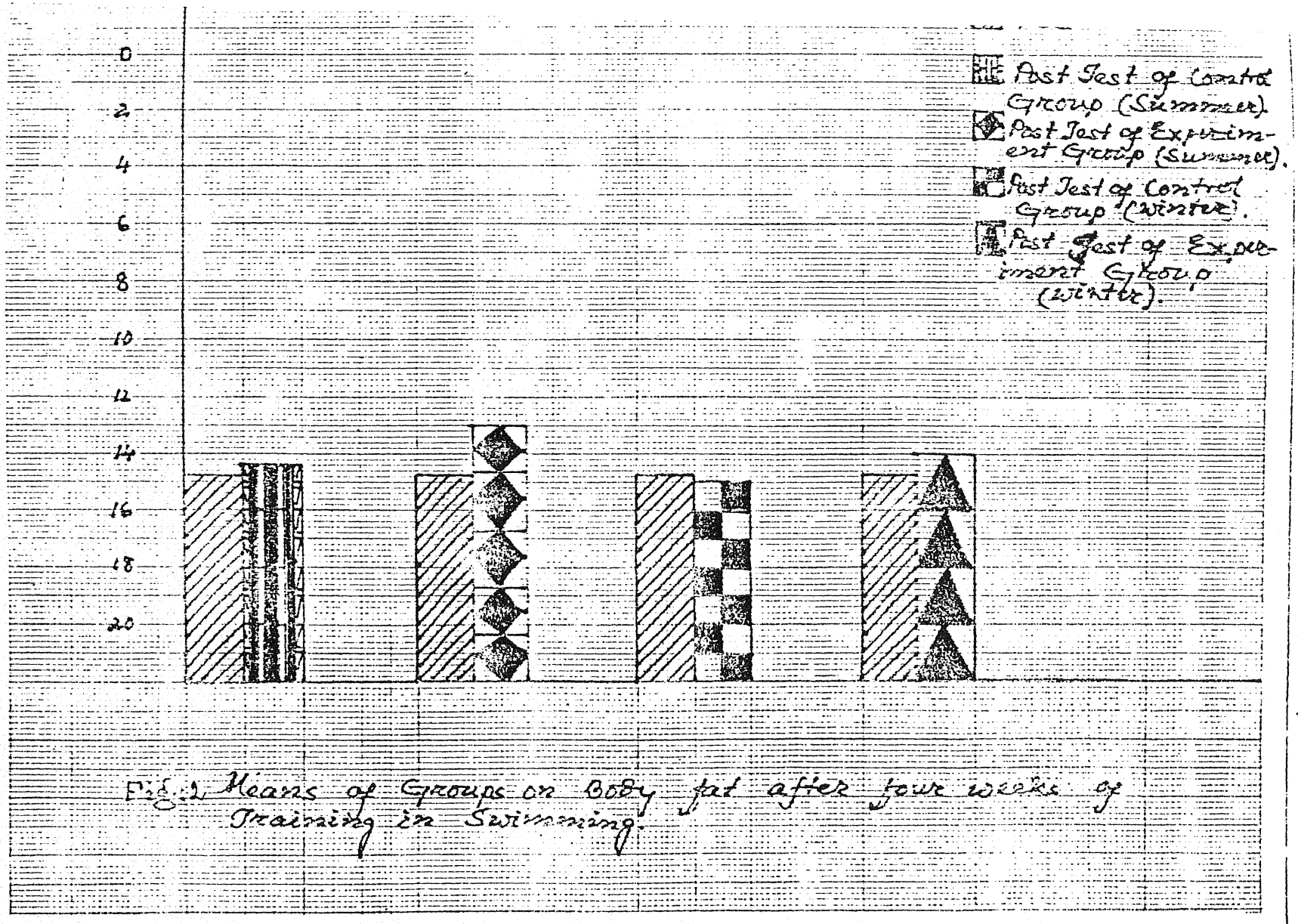

Fig. 2. Means of Groups on Body fat after four weeks of Training in Swimming.

Table-3

Difference between The Paired Means of The Four Groups of Body Fat Changes After Four Weeks of Running Programme

Control group of summer	Experimental group of summer	Control group of winter	Experimental group of winter	MD	CD
14.40	13.02			1.38*	1.062
14.40		14.95		.55	1.062
14.40			13.95	.45	1.062
	13.02	14.95		1.93*	1.062
	13.02		13.95	.93	1.062
		14.95	13.95	1.00	1.092

*Significant at -.05 level of confidence.

Table-3 indicates that the mean differences of 1.38 and 1.93 between the control group of summer season and the experimental group of summer season, and the control group of winter and the experimental group of summer season, are only significant as these values are greater than the confidence interval of 1.062 required for the mean difference to be significant at .05 level. Table further reveals that none of the other mean differences are significant as their values are considerably lower than the required confidence interval value.

Body Fat Changes (After Six weeks of Training) :

One way analysis of variance for the date on body fat changes after six weeks of training programme have been presented in Table 4 and the means of the four groups under two conditions of training have been depicted in Figure-3.

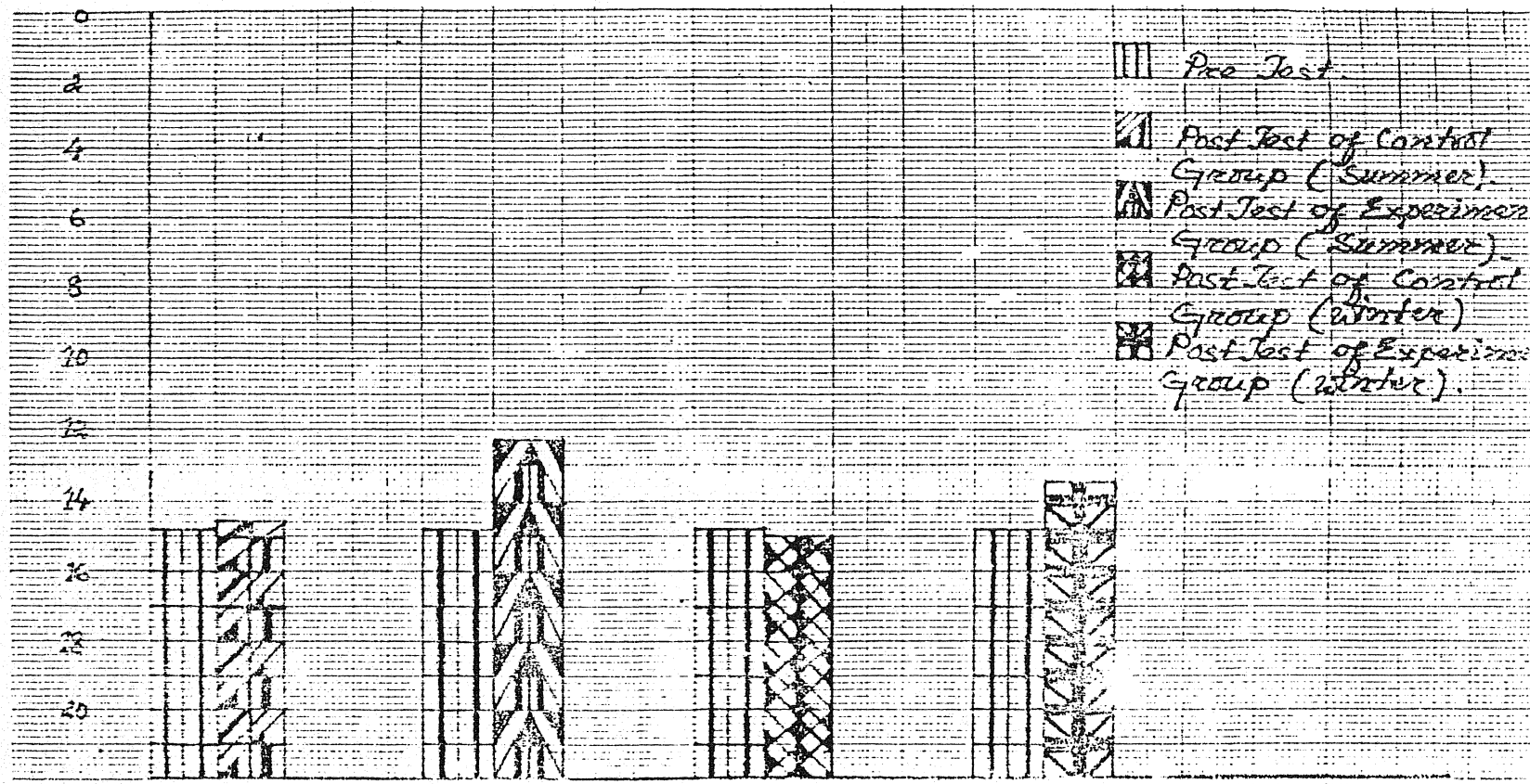

Fig. 3 Means of Groups on body fat after Six Weeks of Training in Swimming.

Table-3

One Way Analysis of Variable For the Data on Body Fat Changes of All The Four Groups After Six Weeks of Training in Running

Sources of Variance	DF	SS	MSS	Obtained (F)	Required Fat .05 level
Between groups	3	115.1986	38.33	24.908*	2.704
Within groups	96	174.7665	1.54		

N = 100

*Significant at .05 level of confidence.

An examination of Table-4 revealed that there was a significant difference in body fat changes among the four groups after six weeks of training in running, as the F ratio of 24.908 obtained was high as compared to the required F .05 (3, 96) = 2.704.

Since the F ratio was significant, Scheffe's 'S' Post Hoc Test was applied to test significance of differences between the paired means.

The mean and the differences between the paired means of the four groups for the body fat changes after six weeks of training in running is presented in Table-5.

Table-5

Difference between The Paired Means of The Four Groups of Body Fat Changes After Six Weeks of Running Programme

Control group of summer	Experimental group of summer	Control group of winter	Experimental group of winter	MD	CD
14.62	12.26			2.36*	.999
14.62		15.01		.39	.999
14.62			13.48	1.14*	.999
	12.26	15.01		2.75*	.999
	12.26	13.48		1.22*	.999
	15.01		13.48	1.53*	.999

*Significant at .05 level of confidence

Table-5 indicates that the mean differences of 2.36, 1.14, 2.75, 1.22 and 1.53 between the control group and experimental group of summer, the control group of summer and the experimental group of winter, the control group of winter and the experimental group of summer, the experimental group of summer and the experimental group of winter, and the control group and the experimental group of winter, respectively are significant as these values are greater than the confidence interval of .999 required for the mean difference to be significant at .05 level of confidence. Table further reveals that there is no significant mean difference between the control group of summer and the control group of winter season as the .39 is considerably lower than the required confidence interval value of .999.

Endurance

Findings pertaining to the improvement of endurance after two weeks of training in running among the four selected groups are given in Table-6.

An examination of Table-6 revealed that there was no significant difference in the performance of Harvard Step Test for endurance among the four groups namely control group of summer, experimental group of summer, control group of winter and experimental group of winter season at .05 level of confidence as the F ratio of 2.05 obtained was lower as compared to the required F .05 (3, 96) = 2.704.

Table-6

One Way Analysis of Variance For the Data on the Performance of Harvard Step Test For Endurance of the four Groups after two weeks of training in running

Sources of Variance	DF	SS	MSS	Obtained (F)	Required Fat .05 level
Between groups	3	44.75	14.92	2.05@	2.704
Within groups	96	6.97.76	7.27		

N = 400

@Not significant at .05 level of confidence.

Endurance (After four weeks training)

One ways analysis of variance for the data on the performance of Harvard Step test for cardio-respiratory endurance of the four groups, after four weeks of training in

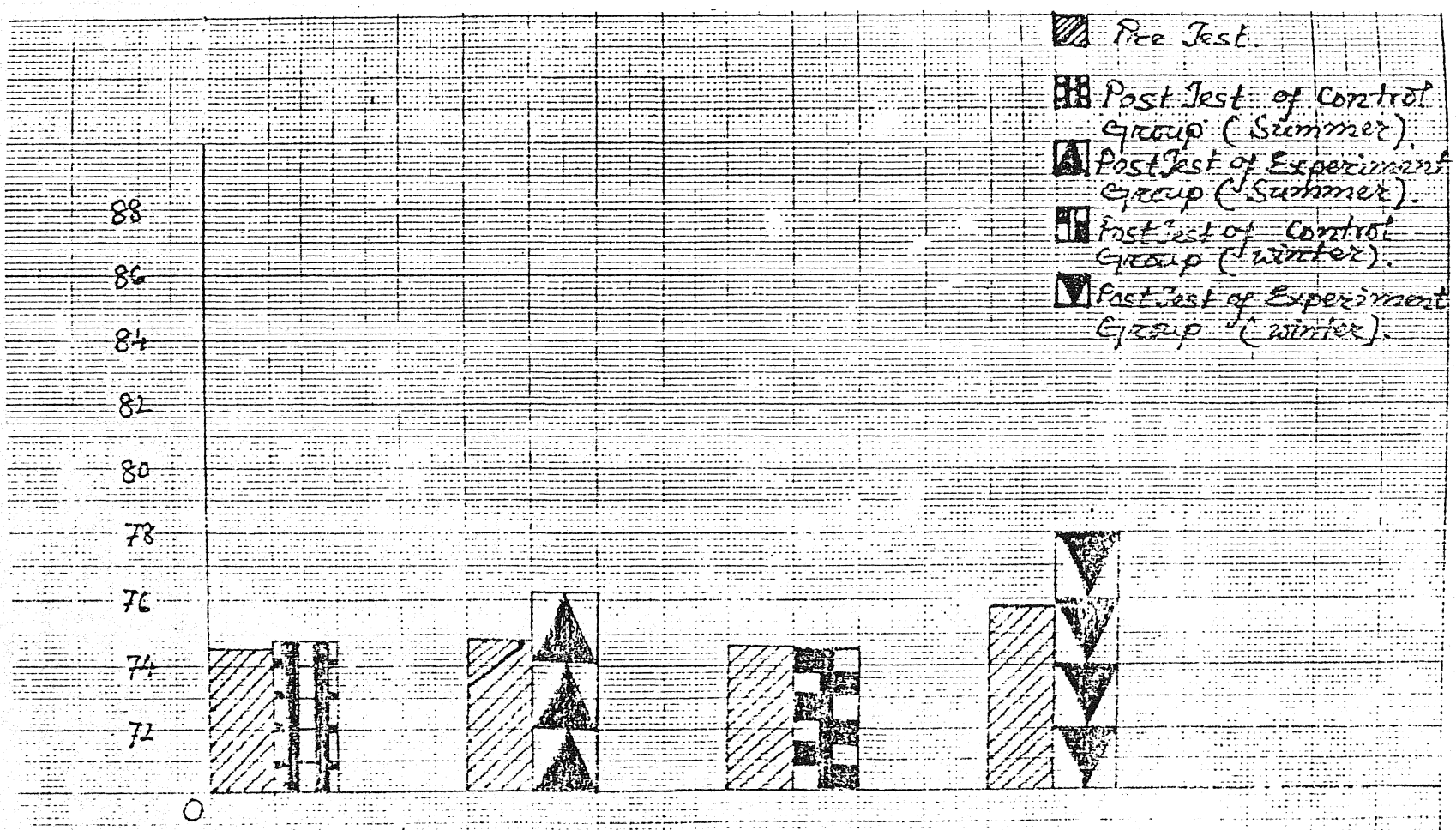

Fig. 4 Mean of Groups on Havard Step Test Performance after four weeks of Training in Swimming.

running has been presented in Table-7 and the means of the four groups under two conditions of training have been depicted in Figure-4.

Table-7

One Way Analysis of Variance For the Data on the Performance of Harvard Step Test For Endurance of the four Groups after Four weeks of training in running

Sources of Variance	DF	SS	MSS	Obtained (F)	Required Fat .05 level
Between groups	3	185.48	61.83	10.6*	2.704
Within groups	96	559.5	5.83		

N = 400

*Significant at .05 level of confidence.

An examination of Table-7 revealed that there was a significant difference in the performance of Harvard Step test for endurance among the four selected groups immediately after the completion of four weeks of training in running, as the F ratio of 10.6 obtained was high as compared to the required F .05 (3, 96) = 2.704.

Since the F ratio was significant, Scheffe's 'S' Post Hoc Test was applied to test significance of differences between the paired means. The mean differences have been presented in Table-8.

Table-8

Difference between The Paired Means of The Four Performance of Harvard Step Test After Four Weeks of Training in Running

Control group of summer	Experimental group of summer	Control group of winter	Experimental group of winter	MD	CD
74.84	76.2			1.36*	1.95
74.84		74.56		.28	1.95
74.84			78	3.16*	1.95
	76.2	74.56		1.64*	1.95
	76.2		78	1.80*	1.95
		74.56	78	3.44*	1.95

*Significant at .05 level of confidence

Table-8 indicates that the mean difference of 3.16 between the control group of summer and the experimental group of winter, and 3.44 between the control group of winter and the experimental group of winter are significant as these values are greater than the confidence interval of 1.95 required for the mean differences to be significant at .05 level of confidence; thus shows a significant improvement of experimental group of winter season on the performance of Harvard stop test for endurance after four weeks of training in running.

Table further revealed that none of the other mean differences are significant as their values are considerably lower than the required confidence interval value.

One way analysis of variance for the data on the performance of Harvard Step test for endurance of the four selected groups after six weeks of training in running has been presented in Table-9, and the means of the four groups under two conditions of training have been depicted in figure -5.

Table-9

One Way Analysis of Variance For the Data on the Performance of Harvard Step Test For Endurance of the four Groups after Six weeks of training in running

Sources of Variance	**DF**	**SS**	**MSS**	**Obtained (F)**	**Required Fat .05 level**
Between groups	3	3.44	114.67	56.52*	2.704
Within groups	96	194.8	2.029		

N = 400

*Significant at .05 level of confidence.

An examination of Table-9 revealed that there was a significant difference in the performance of Harvard Step Test for endurance among the four selected groups after the six weeks of training in running, as the F ratio of 56.52 obtained was quite high as compared to the required F .05 (3.96) = 2.704.

Since the F ratio was significant, Scheffe's 'S' Post Hoc Test was applied to test significance of differences between

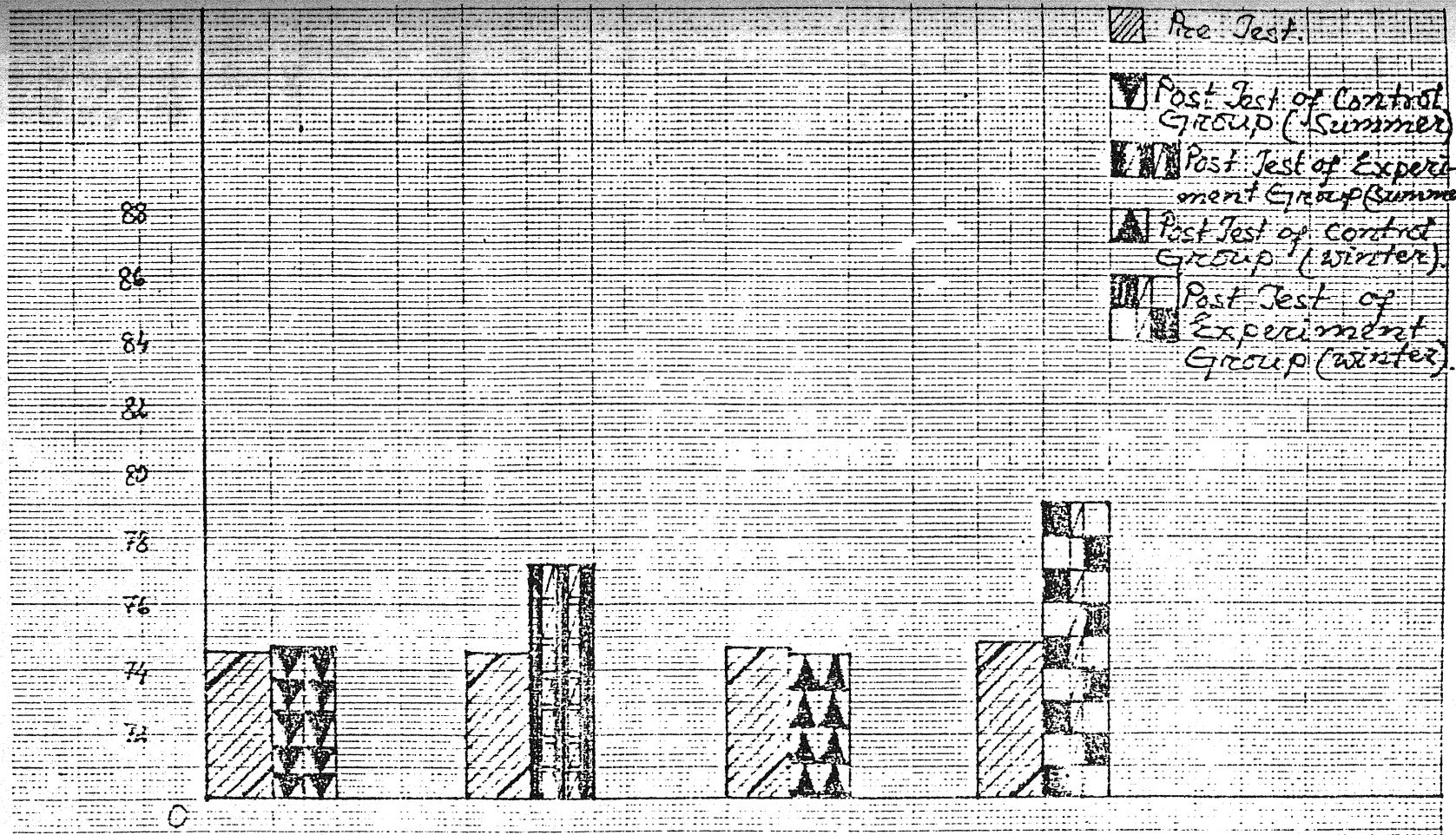

Fig 5 Mean of Groups on Harvard Step Test Performance after Six weeks of Training in Swimming.

the paired means. The mean differences have been presented in Table-10.

Table-10

Difference between The Paired Means of The Four Performance of Harvard Step Test After Four Endurance of The Four Groups After Six Weeks of Training in Running

Control group of summer	Experimental group of summer	Control group of winter	Experimental group of winter	MD	CD
74.68	77.20			2.52*	1.15
74.68		74.48		.20	1.15
74.68			79	4.32*	1.15
	77.20	74.48		2.72*	1.15
	77.20		79	1.80*	1.15
		74.48	79	4.52*	1.15

*Significant at .05 level of confidence

Table-10 indicates that the mean differences of 2.52 between the control group of summer and experiment group of summer, 4.32 between the control group of summer and experimental group of winter, 2.72 between the control group of winter and experimental group of summer, 1.80 between the experimental group of summer and experimental group of winter and 4.52 between the control of winter and experimental group of winter season are significant as these values are

greater than the confidence interval of 1.15 required for the mean differences to be significant at .05 level, this show a significant improvement of experimental group of winter as well as summer on the performance of Harvard Step test for endurance after six weeks of training in running.

Table further shows that the experimental group of winter has shown a greater improvement compared to the experimental group of summer and both the control groups, the experimental group of summer has got also a significant improvement on the performance than the control groups. But there is no significant difference of the mean performance between the control group of the summer and the control group of winter as the mean difference of .20 is lesser than the required confidence interval value of 1.15.

Findings :

A. Body Fat Changes :

i) After two weeks of training in running there was no significant difference among the four groups. (Table-1)

ii) After four weeks of training in running, Table-2 showed that there was significant difference among the four groups and Table-3 further shows that the experimental group of summer has shown the significant reduction of body fat compared to the other groups.

iii) After six weeks of training in running, Table-4 showed

that there was a significant difference among the four groups and Table-5 further shows that the experimental group of summer and winter both have shown the significant changes in body fat, again it was also revealed that the experimental group of summer has shown the greater reduction of body fat percentage.

B. <u>Cardiorespiratory Endurance</u> : Improvement.

i) After two weeks of training in running there was no significant improvement among the four groups as Table-6 revealed.

ii) After four weeks of training in running Table-7 showed there was a significant difference among the four groups and Table-8 reveals that significant improvement in cardiorespiratory endurance has shown by the experimental group of winter.

iii) After six weeks of training in running from Table-9 it was clear that there was a significant difference among the means of the four groups and Table-10 further revealed that both the experimental groups have shown significant improvement in the cardiorespiratory endurance, and it was further shown from table-10 that the greater improvement has taken place among the subjects of experimental group of winter.

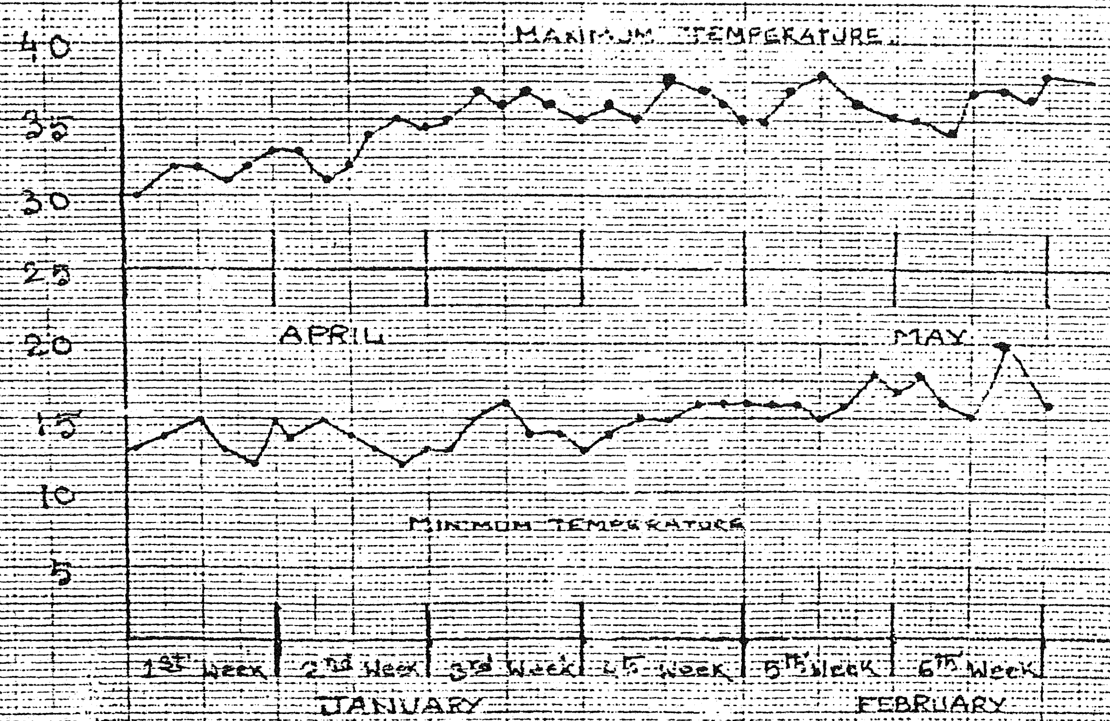

Fig-7 Variat[illegible] of Water Temperature of Swimming Pool.

Discussion :

The analysis of data has clearly revealed that there is no significant difference towards the body fat changes after two weeks of training in summer and winter. It may be because two weeks training in running is not sufficient to reduce the body fat percentage among the subjects. But Table-1 further reveals that the rate of reduction of body fat occurs a little higher among the subjects of summer's experimental group than the winter's experimental group. It may be attributed to the climatic condition and dietary habits of the subjects.

The findings of Table 2 and 3 show that there is a significant difference towards the body fat changes among the four groups after four weeks of training. The findings also reveal that the significant body fat changes occur among the subjects of summer's training group.

The reason for the greater reduction of body fat may be attributed to the climatic condition as well as duration of the training programme.

The subjects of the winter training group does not show the reduction of body fat significantly, it may be because running in relatively cold water placed the runner under thermal stress and brings about metabolic adjustment; thus the subjects benefit less from the insulation of subcutaneous fat.[3]

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[3]*William D. Mc Ardle et al., Exercise Physiology. Philadelphia: Lea & Febiger, 1986, p. 162*

The findings of Table-4 and 5 reveal that after six weeks of running in summer and winter reduce the body fat percentage significantly. The reason for the higher reduction of body fat may be the duration of six weeks programme is enough for reducing body fat.

The findings further show that the rate of reduction between the summer and winters group significantry differs. The subjects of summer's running group shows the greater improvement towards the body fat changes; the reason may be obesity is a liability when working in hot. Because the specific heat of fat is much greater than that of muscle tissue, excess fat increases the insulatory quality of the body shell and retards conduction of heat to the periphery.[4]

From Table-6 the findings show that there is no significant difference towards the improvement of endurance between the groups after two weeks of running programme in summer and in winter. The reason may be only two weeks running programme is not sufficient to enhance endurance of the subjects.

The analysis of data of Table-7 and 8 indicates that there is a significant improvement of endurance of winter's experimental group. The findings also reveal that the summer running group also improved cardiorespiratory endurance but not significantly. The reason for the higher improvement of

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[4]*Ibid., p. 457*

winter's experimental group may be attributed to the running in relatively cold water places the runner under thermal stress and brings about metabolic and cardiovascular adjustment that are different from those observed in warmer water. These responses are geared primarily toward maintaining a relative consistency in core temperature and minimize the energy cost so as to running can be continued for a prolonged duration which ultimately increases cardiorespiratory endurance.[5]

The findings of Table-9 and 10 indicate that after six weeks running programme in both summer and winter improve endurance significantly. Tables further reveal that though both the training groups improved endurance but greater improvement occurs in the winter training group. It may be because of climatic condition which is already mention in the previous paragraph.

Hypothesis :-

In the beginning of the study it was hypothesised that running in winter will increase the body fat and develops the cardiorespiratory endurance. But the result of this study shows that running in winter has got the significant effect on reduction of body fat and development of the cardiorespiratory endurance. So the hypothesis is rejected in the case of body fat reduction and in the case of cardiorespiratory endurance hypothesis is accepted.

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[5]*Nadel E. et al., "Energy Exchanges of Running Man" J. Applied Physiology, 36 (1974), p. 465.*

CHAPTER - V

SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATIONS

CHAPTER - V
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Technology permeates every aspect of life. Sport is no exception to it. Sport has become part and parcel of modern life as the millions participate in it to derive the benefits. Nowadays sport is a wide term which includes games, athletics and swimming. Running is a very healthy activity because it exercises all the muscles and keep the body in tune. Obesity is not only unattractive but also a serious health hazard. It increases susceptibility to number of diseases and disorders. The loss of weight to the level may help to develop the cardiorespiratory endurance which is basic component of physical fitness.

The purpose of the study was to find out the effect of running in summer and winter on the body fat and cardiorespiratory endurance of women athletes.

The purpose of the duty was to find out the effect of running in summer and winter on the body fat and cardiorespiratory endurance of women athletes.

The main interest of the research scholar was to know the best seasonal training for reduction of the body fat and improvement of the cardiorespiratory endurance which might be adopted by the athletes as well as coaches and physical education teacher.

Further the results of this study would provide a guideline to competitors to develop the fitness and performance in the suitable climatic conditions.

Based upon literature related to this study and personal experience of the research scholar it was hypothesised that running in winter might have the greater influence on reduction of body fat and improvement of cardiorespiratory endurance.

The study was delimited to the 400 female runners between 17 to 20 years of age belonging to different areas, and this study was restricted to two variables of body fat and cardiorespiratory endurance.

The dietary habits and regular activities besides this training were not controlled by the researcher which is considered as the limitation of the study.

The subjects for this study were tested on Harvard Step Test initially. On the basis of the initial test scores the subjects were divided into four homogeneous groups of 100 subjects in each. The data were collected prior to the experimental treatment and then after every two weeks, for six weeks of experimental periods in summer and winter; out of these, two groups were kept as control groups and two groups acted as experimental groups.

The experimental groups were trained six days a week for six weeks in summer and in winter, and no trainings were given to both the control groups.

Testing was done for the criterion measures of the body fat percentage and cardiorespiratory endurance by employing the skinfold measurements using four selected sites of the body and Harvard Step test respectively; initially, after two weeks, after four weeks and finally after six weeks to study the biweekly body fat and endurance changes. The data collected was examined by one way Analysis of Variance. In case of significant F ratio at .05 level, the Scheffe's S Post Hoc Test was applied to ascertain the significance of difference between the paired means.

The analysis of data revealed that there were no significant changes in any of the criterion measures after two weeks of training in running. However when initial and final (4 weeks and 6 weeks) means were compared the significant differences were found in body fat changes and endurance in both the experimental groups; group of summer showed a greater reduction of body fat and the experimental group of winter showed a greater improvement of endurance. The control groups did not show any significant improvement either in body fat changes for endurance in summer and winter when initial means were compared with the final means.

FINDINGS :

Fat Changes :

1. There were no significant differences between the summer and winter training in running on body fat and endurance after two weeks of training programme.

2. Training in running in summer can reduce the body fat, but for this minimum period of training schedule should be at least four weeks and for better result more than four weeks of training is required.

3. Endurance can be developed through the training in running in both summer and winter season, but training in winter shows the greater improvement provided that at least four to six weeks of duration is required.

CONCLUSION :

Based on the findings, discussion of findings and within the limitation of the present study, it may be concluded that for the significant refuction of body fat, at least six weeks of training in running may be prescribed and summer season should be preferred for better result; and at least six weeks of training in running preferably in the winter season may be advised for the significant improvement of cardiorespiratory endurance.

RECOMMENDATIONS :

In the light of conclusion drawn the following recommendations have been made :

1. Training in running may be adopted for reducing the body fat.

2. For improving the endurance, training in running may be used.

3. For greater reduction of the body fat, training in running in summer may be suggested as the best season.

4. Training in winter season may be prescribed for the better improvement of cardiorespiratory endurance.

5. Studies may be undertaken on subjects of age and sex other than those employed in this study.

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APPENDIX-A

PHYSICAL FITNESS GROUP OF WINTER

MEASUREMENT OF SKINFOLD THICKNESS (MM)

	INITIAL TEST			SECOND TEST				THIRD TEST				FOURTH TEST			
s	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
2	5.6	6	7.1	4.2	5.6	6.0	7.1	4	5.4	5.8	7	42	5.8	6.1	7.2
	6.8	6.2	7	4	6.8	6.2	7.1	4.5	7.3	6.9	7.1	4.4	7.1	7.5	7.8
5	7.5	7.6	7.4	4.5	7.5	7.6	7.5	4.2	7.3	7.2	7.1	4.5	7.1	7.5	7.8
	5.7	6.0	7.2	4.2	5.7	6.0	7.2	4.1	5.7	5.0	7.2	4.3	6	6.1	7.2
8	7.4	8	7.8	4.8	7.3	8	7.8	4.6	7.2	8	8	4.8	7.4	8	7.8
4	6.5	6.9	7.4	4.4	6.5	6.9	7.4	4.4	6.5	6.9	7.4	4.8	6.8	7	7.4
2	6.6	6.2	7.1	4.0	6.6	6.2	7	4.3	6.6	6.5	7.1	4.4	6.6	6.2	7.1
5	7.1	7.5	8	4.8	7.2	7.6	8	4.4	7	7.3	8	4.5	7.1	7.5	8
2	5.6	7.3	4.9	4.3	5.7	7.4	5.7	4.3	6	7.5	5.2	4.3	5.9	6.3	7.4
	5.1	6	5	4.2	5.2	6.1	5.1	5.2	6.1	6.4	7	4.2	5.3	7.6	4.2
	5.6	6.3	7.4	4.1	5.9	6.5	7.5	4	5.2	6	7.1	4.2	5.5	7	5.2
2	5.5	7	5.4	4	5.2	6.8	5.2	4	5.2	7	5	4.3	5.7	7.3	5.9
8	7.1	8.3	7.9	4.8	6.9	8	7.7	4.6	7	8.3	7.9	4.8	7.4	8.6	7.2
6	5.9	6.5	6.6	5	6	6.6	6.9	5	6.1	6.6	7.2	4.4	6.3	6.2	73
2	5.8	6.1	7.2	4.2	5.8	6.1	7.2	4.4	6	6.4	7.3	42	5.6	6.0	7.1
8	6.8	8.1	7.1	5	6.9	8.1	7.3	4.7	6.5	3.1	7	4.3	7.3	7.5	7.1
4	6.1	6.7	6.8	4.6	6.3	7	7.2	4.6	69	7.2	7.1	4.2	6.9	7.1	7
2	5.1	7.4	4.2	4.5	5.4	7.4	4.5	4.5	5.9	7.6	7.1	4.2	5.2	7	5.2
9	4.9	5.9	4.9	3.9	5.9	6.2	5.2	3.9	4.9	5.9	4.9	3.9	5	6.5	5.2
2	5.5	7	5.2	4.9	5.7	7.3	5.4	4.4	5.0	7.4	7.1	4.1	5.5	5.7	7.2
	5	5.8	5	4	5	5.2				5.8	5	3.9	4.9	5.9	4.9
4	6.7	6.7	7.3	4.7	7	7.2	7.3	5.2	7	7.1	7.4	4.3	7.1	7	7.6
5	7.2	7.6	7.3	4.2	7	7.4	7.1	4.7	7.4	8.6	7.2	4.8	7.4	8.6	7.2
3	7.4	8.6	7.2	4.6	7.2	8.5	7.0	8.0	7.5	3	7	4.9	7.6	8.7	8
4	7.4	7.2	7.8	4.6	7.6	7.4	7.1	4.4	6.7	7.1	7.6	4.6	7.1	7	7.4

INITIAL TEST			SECOND TEST				THIRD TEST				FOURTH TEST			
Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
5.1	6.3	5.2	4.2	5.2	6.1	5.1	5.2	6.1	6.4	7.3	4.2	5.3	7.6	4.2
7.2	4.4	6.0	6.4	7.3	42	5.6	6.0	7.1	6.5	7.1	4.4	6.6	6.2	7.1
7.5	7.6	7.4	4.5	7.5	7.6	7.5	4.2	7.3	7.2	7.1	4.5	7.1	7.5	7.8
5.7	6.0	7.2	4.2	5.7	6.0	7.2	4.1	5.7	5.0	7.2	4.3	6.0	6.1	7.2
7.4	8.5	7.8	4.8	7.3	6.8	7.8	4.6	7.2	7.8	8.0	4.8	7.4	8.1	7.8
6.5	6.9	7.4	4.4	6.5	6.9	7.4	4.4	6.5	6.9	7.4	4.8	6.8	7.2	7.4
6.6	6.2	7.1	4.0	6.6	6.2	7.2	4.3	6.6	6.5	7.1	4.4	6.6	6.2	7.1
7.1	7.5	8.0	4.8	7.2	7.6	8	4.4	7	7.3	8	4.5	7.1	7.5	8
5.6	7.3	4.9	4.3	5.7	7.4	5.7	4.3	6	7.5	5.2	4.3	5.9	6.3	7.4
5.1	6.3	5.5	4.2	5.2	6.1	5.1	5.2	6.1	6.4	7	4.2	5.3	7.6	4.2
5.6	6.3	7.4	4.1	5.9	6.5	7.5	4	5.2	6	7.1	4.2	5.5	7	5.2
7.2	4.4	6	6.4	7.3	42	5.6	6.0	7.1	7	5	4.3	5.7	7.3	5.9
7.1	8.3	7.9	4.8	6.9	8	7.7	4.6	7	8.3	7.9	4.8	7.4	8.6	7.2
5.9	6.5	6.6	5	6	6.6	6.9	5	6.1	6.6	7.2	4.4	6.3	6.2	73
5.8	6.1	7.2	4.2	5.8	6.1	7.2	4.4	6	6.4	7.3	42	5.6	6.0	7.1
6.8	8.1	7.1	5	6.9	8.1	7.3	4.7	6.5	3.1	7	4.3	7.3	7.5	7.1
6.1	6.7	6.8	4.6	6.3	7	7.2	4.6	69	7.2	7.1	4.2	6.9	7.1	7
5.1	7.4	4.2	4.5	5.4	7.4	4.5	4.5	5.9	7.6	7.1	4.2	5.2	7	5.2
4.9	5.9	4.9	3.9	5.9	6.2	5.2	3.9	4.9	5.9	4.9	3.9	5	6.5	5.2
5.5	7	5.2	4.9	5.7	7.3	5.4	4.4	5.0	7.4	7.1	4.1	5.5	5.7	7.2
5	5.8	5	4	5.6	5.2	6.6	4.9	5.2	5.8	5	3.9	4.9	5.9	4.9
6.7	6.7	7.3	4.7	7.2	7.2	7.3	5.2	7.2	7.1	7.4	4.3	7.1	7	7.6
7.2	7.6	7.3	4.2	7.3	7.4	7.1	4.7	7.4	8.6	7.2	4.8	7.4	8.6	7.2
7.4	8.6	7.2	4.6	7.2	8.5	7.0	8.0	7.5	3	7	4.9	7.6	8.7	8
7.4	7.2	7.8	4.6	7.6	7.4	7.1	4.4	6.7	7.1	7.6	4.6	7.1	7	7.4

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
s	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
	7.1	7.5	8	4.8	7.2	7.6	8	4.4	7	7.3	8	4.5	7.1	7.5	8.2
	7.4	8	7.8	4.8	7.3	8	7.8	4.6	7.2	8	8	4.8	7.4	8	7.8
	6.5	6.9	7.4	4.4	6.5	6.9	7.4	4.4	6.5	6.9	7.4	4.8	6.8	7	7.4
	5.7	6.0	7.2	4.2	5.7	6.0	7.2	4.1	5.7	5.0	7.2	4.3	6	6.1	7.2
3	7.4	8	7.8	4.8	7.3	8	7.8	4.6	7.2	8	8	4.8	7.4	8	7.8
4	6.5	6.9	7.4	4.4	6.5	6.9	7.4	4.4	6.5	6.9	7.4	4.8	6.8	7	7.4
2	6.6	6.2	7.1	4.0	6.6	6.2	7	4.3	6.6	6.5	7.1	4.4	6.6	6.2	7.1
5	7.1	7.5	8	4.8	7.2	7.6	8	4.4	7	7.3	8	4.5	7.1	7.5	8
2	5.6	7.3	4.9	4.3	5.7	7.4	5.7	4.3	6	7.5	5.2	4.3	5.9	6.3	7.4
1	5.1	6	5	4.2	5.2	6.1	5.1	5.2	6.1	6.4	7	4.2	5.3	7.6	4.2
2	5.6	7.3	4.9	4.3	5.7	7.4	5.7	4.3	6	7.5	5.2	4.3	5.9	6.3	7.4
2	5.5	7	5.4	4	5.2	6.8	5.2	4	5.2	7	5	4.3	5.7	7.3	5.9
8	7.1	8.3	7.9	4.8	6.9	8	7.7	4.6	7	8.3	7.9	4.8	7.4	8.6	7.2
6	5.9	6.5	6.6	5	6	6.6	6.9	5	6.1	6.6	7.2	4.4	6.3	6.2	73
8	7.1	8.3	7.9	4.8	6.9	8	7.7	4.6	7	8.3	7.9	4.8	7.4	8.6	7.2
8	6.8	8.1	7.1	5	6.9	8.1	7.3	4.7	6.5	3.1	7	4.3	7.3	7.5	7.1
4	6.1	6.7	7.9	4.8	6.9	8	7.7	4.6	7	8.3	7.9	4.8	7.4	8.6	7.2
.2	5.1	7.4	4.2	4.5	5.4	7.4	4.5	4.5	5.9	7.6	7.1	4.2	5.2	7	5.2
.9	4.9	5.9	4.9	3.9	5.9	6.2	5.2	3.9	4.9	5.9	4.9	3.9	5	6.5	5.2
.2	5.5	7	5.2	4.9	5.7	7.3	5.4	4.4	5.0	7.4	7.1	4.1	5.5	5.7	7.2
	5	5.8	5	4	5.6	5.2	6.2	5.0	4.5	5.8	5	3.9	4.9	5.9	4.9
.4	6.7	6.7	7.3	4.7	7.2	7.2	7.3	5.2	7.0	7.1	7.4	4.3	7.1	7	7.6
.5	7.2	7.6	7.3	4.2	7.1	7.4	7.1	4.7	7.4	8.6	7.2	4.8	7.4	8.6	7.2
.3	7.4	8.6	7.2	4.6	7.2	8.5	7.0	8.0	7.5	3	7	4.9	7.6	8.7	8
.4	7.4	7.2	7.8	4.6	7.6	7.4	7.1	4.4	6.7	7.1	7.6	4.6	7.1	7	7.4

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
2	5.6	6	7.1	4.2	5.6	6.0	7.1	4	5.4	5.8	7	42	5.8	6.1	7.2
	6.8	6.2	7	4	6.8	6.2	7.1	4.5	7.3	6.9	7.1	4.4	7.1	7.5	7.8
5	7.5	7.6	7.4	4.5	7.5	7.6	7.5	4.2	7.3	7.2	7.1	4.5	7.1	7.5	7.8
1	5.7	6.0	7.2	4.2	5.7	6.0	7.2	4.1	5.7	5.0	7.2	4.3	6	6.1	7.2
8	7.4	8	7.8	4.8	7.3	8	7.8	4.6	7.2	8	8	4.8	7.4	8	7.8
4	6.5	6.9	7.4	4.4	6.5	6.9	7.4	4.4	6.5	6.9	7.4	4.8	6.8	7	7.4
2	6.6	6.2	7.1	4.0	6.6	6.2	7	4.3	6.6	6.5	7.1	4.4	6.6	6.2	7.1
5	7.1	7.5	8	4.8	7.2	7.6	8	4.4	7	7.3	8	4.5	7.1	7.5	8
2	5.6	7.3	4.9	4.3	5.7	7.4	5.7	4.3	6	7.5	5.2	4.3	5.9	6.3	7.4
1	5.1	6	5	4.2	5.2	6.1	5.1	5.2	6.1	6.4	7	4.2	5.3	7.6	4.2
1	5.6	6.3	7.4	4.1	5.9	6.5	7.5	4	5.2	6	7.1	4.2	5.5	7	5.2
2	5.5	7	5.4	4	5.2	6.8	5.2	4	5.2	7	5	4.3	5.7	7.3	5.9
8	7.1	8.3	7.9	4.8	6.9	8	7.7	4.6	7	8.3	7.9	4.8	7.4	8.6	7.2
6	5.9	6.5	6.6	5	6	6.6	6.9	5	6.1	6.6	7.2	4.4	6.3	6.2	73
2	5.8	6.1	7.2	4.2	5.8	6.1	7.2	4.4	6	6.4	7.3	42	5.6	6.0	7.1
8	6.8	8.1	7.1	5	6.9	8.1	7.3	4.7	6.5	3.1	7	4.3	7.3	7.5	7.1
4	6.1	6.7	6.8	4.6	6.3	7	7.2	4.6	69	7.2	7.1	4.2	6.9	7.1	7
2	5.1	7.4	4.2	4.5	5.4	7.2	7.3	5.2	7	7.1	7.4	4.3	7.1	7	7.6
9	4.9	5.9	4.9	3.9	5.9	6.2	5.2	3.9	4.9	5.9	4.9	3.9	5	6.5	5.2
2	5.5	7	5.2	4.9	5.7	7.3	5.4	4.4	5.0	7.4	7.1	4.1	5.5	5.7	7.2
8	7.4	8.6	7.2	4.6	7.2	8.5	7.0	8.0	7.5	3	7	4.9	7.6	8.7	8
4	6.7	6.7	7.3	4.7	7	7.2	7.3	5.2	7	7.1	7.4	4.3	7.1	7	7.6
5	7.2	7.6	7.3	4.2	7	7.4	7.1	4.7	7.4	8.6	7.2	4.8	7.4	8.6	7.2
4	7.4	7.2	7.8	4.6	7.6	7.4	5.3	8.0	7.5	3	7	4.9	7.6	8.7	8
4	7.4	7.2	7.8	4.6	7.6	7.4	7.1	4.4	6.7	7.1	7.6	4.6	7.1	7	7.4

PHYSICAL FITNESS GROUP OF WINTER

HARVARD STEP TEST PULSE COUNT (NO.)

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
70	66	65	69	64	61	72	66	61	72	67	61
72	66	61	72	66	61	69	64	61	70	68	58
74	66	62	74	66	62	74	66	60	74	68	60
72	66	62	72	68	62	72	68	65	74	66	60
74	68	66	76	71	64	76	72	68	76	70	65
72	68	65	72	68	65	74	68	60	74	69	65
74	64	62	72	68	57	74	60	60	72	67	61
72	68	57	69	64	61	72	66	61	69	64	61
72	66	62	72	67	61	70	64	60	70	62	57
68	65	59	70	62	57	70	66	65	69	64	61
69	64	61	72	68	57	72	67	61	74	68	60
76	72	68	76	70	65	74	68	66	72	68	57
72	67	61	70	66	61	70	64	60	72	67	61
70	66	61	72	68	62	72	67	61	68	64	62
68	65	59	69	64	61	72	60	60	72	67	61
73	67	62	72	68	65	68	64	60	68	65	62
69	67	61	70	66	61	74	68	60	72	66	59
72	67	61	74	68	60				72	68	65
72	68	65	72	68	65	72	49	60	74	69	65
74	69	65	74	69	65	74	68	66	74	68	60
68	64	60	70					60	76	72	68
70	66	61	76	71	64	72		65	74	69	65
72	68	65	72	66	65	74	62	68	72	68	62
76	71	64	76	72	68			63	72	68	65
74	68	60	74	69	65			64	76	71	64

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
72	66	62	72	68	62	72	68	65	74	66	60
72	66	61	72	66	61	69	64	61	70	68	58
74	66	62	74	66	62	74	66	60	74	68	60
72	66	62	72	68	62	72	68	65	74	66	60
74	66	62	74	66	62	74	66	60	74	68	60
72	68	65	72	68	65	74	68	60	74	69	65
74	64	62	72	68	57	74	60	60	72	67	61
69	64	61	72	68	57	72	67	61	74	68	60
74	64	62	72	68	57	74	60	60	72	67	61
68	65	59	70	62	57	70	66	65	69	64	61
69	64	61	72	68	57	72	67	61	74	68	60
76	72	68	76	70	65	74	68	66	72	68	57
72	67	61	70	66	61	70	64	60	72	67	61
70	66	61	72	68	62	72	67	61	68	64	62
76	72	68	76	70	65	74	68	66	72	68	57
73	67	62	72	68	65	68	64	60	68	65	62
69	67	61	70	66	61	74	68	60	72	66	59
72	67	61	70	66	61	74	68	60	72	66	59
72	68	65	72	68	65	72	49	60	74	69	65
74	69	65	74	69	65	74	68	66	74	68	60
68	64	60	70	65	72	49	60	74	69	65	65
68	65	72	68	65	72	49	60	74	69	65	45
72	68	65	72	66	65	74	62	68	72	68	62
76	71	68	76	70	65	74	68	66	72	68	57
74	68	60	72	66	65	74	62	68	72	68	62

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
70	66	65	69	64	61	72	66	61	72	67	61
72	68	57	74	60	60	72	67	61	70	62	57
72	68	57	69	64	61	72	66	61	69	64	61
72	66	62	72	67	61	70	64	60	70	62	57
74	64	62	72	68	57	74	60	60	72	67	61
72	68	57	69	64	61	72	66	61	69	64	61
72	66	62	72	67	61	70	64	60	70	62	57
74	64	62	72	68	57	74	60	60	72	67	61
72	68	57	69	64	61	72	66	61	69	64	61
72	66	62	72	67	61	70	64	60	70	62	57
68	65	59	70	62	57	70	66	65	69	64	61
69	64	61	72	68	57	72	67	61	74	68	60
76	72	68	76	70	65	74	68	66	72	68	57
72	67	61	70	66	61	70	64	60	72	67	61
70	66	61	72	68	62	72	67	61	68	64	62
68	65	59	69	64	61	72	60	60	72	67	61
73	67	62	72	68	65	68	64	60	68	65	62
69	67	61	70	66	61	74	68	60	72	66	59
70	66	61	72	68	62	72	67	61	68	64	62
72	68	65	72	68	65	72	49	60	74	69	65
74	69	65	74	69	65	74	68	66	74	68	60
70	66	61	72	60	62	72	67	61	68	64	62
74	69	65	74	66	61	73	68	66	74	68	60
72	68	65	72	66	63	74	62	68	72	68	62
74	69	65	74	69	62	78	68	66	74	68	60

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
75	64	67	65	68	61	72	66	61	72	67	61
72	66	61	72	66	61	69	64	61	70	68	58
74	66	62	74	66	62	74	66	60	74	68	60
72	66	62	72	68	62	72	68	65	74	66	60
74	66	62	74	66	62	74	66	60	74	68	60
72	66	62	72	68	62	72	68	65	74	66	60
74	64	62	72	68	57	74	60	60	72	67	61
72	68	57	69	64	61	72	66	61	69	64	61
72	66	62	72	67	61	70	64	60	70	62	57
71	67	61	70	66	61	70	64	60	72	67	61
69	64	61	72	68	57	72	67	61	74	68	60
72	68	57	69	64	61	72	66	61	69	64	61
72	67	61	70	66	61	70	64	60	72	67	61
70	66	61	72	68	62	72	67	61	68	64	62
68	65	59	69	64	61	72	60	60	72	67	61
70	64	63	76	67	68	69	64	60	68	65	62
68	65	59	69	64	61	72	60	60	72	67	61
72	67	61	74	68	60	70	62	64	72	68	65
72	68	65	72	68	65	72	49	60	74	69	65
74	69	65	74	69	65	74	68	66	74	68	60
70	64	63	76	67	68	69	64	60	68	65	62
70	66	61	76	71	64	72	66	65	74	69	65
72	68	65	72	66	65	74	62	68	72	68	62
76	71	64	76	72	68	73	64	63	72	68	65
74	68	60	74	69	65	72	65	64	76	71	64

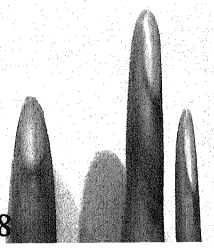
CONTROL GROUP OF SUMMER

MEASUREMENT OF SKINFOLD THICKNESS (MM)

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
.4	5.7	7.6	4.3	4.4	5.5	7.4	4.3	4.4	5.4	7.2	4.2	4.4	5.4	7.1	5
8	7.4	8.6	7.2	4.7	7.3	8.5	7	4.6	7.2	8.4	7.	4.6	7.4	8.4	7.5
2	5.8	7.3	4.7	4.2	5.7	7.1	4.6	4.2	5.5	6.9	4.4	4.2	5.6	7.1	5
	5	7.6	4.4	4	5	7.6	4.4	4	4.8	7.0	4.4	4	4.8	6.5	5.8
	5	6	5.5	4	5	5.8	5.1	4	5	5.6	4.9	4	5	5.7	5.5
6	7.4	7.8	7.2	4.4	7.1	7.7	7.1	4.4	7	7.5	7	4.4	7	7.5	7.5
5	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7	7.2	6.8	4.4	7.3	7.2	7.6
3	7.4	8	7.8	4.7	7.2	7.8	7.5	4.4	7.3	7.1	7.2	4.4	7.3	7.5	7.6
6	6.2	6.2	7	4.6	6.2	6.2	7	4.4	6	6	6.9	4.4	6	6.4	7.2
2	5.6	6.1	7.1	4.2	5.6	6.1	7.1	4.2	5.5	6.1	7	4.2	5.5	6.1	7
6	6.5	6.8	7.2	4.4	6.3	6.5	7.1	4.4	6.1	6.3	7	4.4	6.1	6.6	7.2
2	5.6	6	7.2	4.2	5.6	6	7.2	4.2	5.4	6	7	4.2	5.4	6	7
1	5.8	6.2	7	4	6.3	6.2	7	4	6.5	6.1	6.8	4	6.8	6.4	7
1	7.2	8.4	7.8	4.8	7.1	8.1	7.5	4.8	7	8	7.2	4.8	7	8.2	7.6
	6.8	8	7.1	4.7	6.8	7.6	7.1	4.6	6.8	7.4	7	4.6	6.8	7.6	7.4
	6.6	6.7	7.4	4.4	6.6	6.5	7	4.4	6.5	6.5	6.8	4.4	6.5	7	6.8
	6.6	6.8	7.4	4.8	6.6	6.8	7.4	4.8	6.6	6.6	7.1	4.8	6.6	6.6	6.8
	5.5	7.0	5.2	4.2	5.5	6.4	5.1	4.2	5.4	6.3	5.0	4.2	5.4	6.3	5.6
	4.9	6	6.1	3.3	4.9	5.9	5.8	3.3	4.9	5.5	5.6	3.3	4.9	5.6	5.8
	4.8	5.2	5.2	4	4.3	5.2	5.2	4	4.8	5.2	5.2	4	4.8	5.2	5.2
	5.9	6.6	6.6	4.5	5.3	6.4	6.3	4.5	5.8	6.4	6.3	4.5	5.8	6.8	6.6
	5.8	6.4	6.3	4.4	5.9	6.8	6.6	4.6	5.9	6.8	6.6	4.4	5.9	6.1	5.4
	7.1	8	5.7	4.6	5.9	6.9	6.8	4.6	5.9	6.7	6.6	4.6	6.2	6.8	7
	5.0	6.6	6.1	4.2	4.6	5.6	5.9	4.2	5	5.5	5.5	4.2	5	5.5	5.1
	6.1	4.7	4.8	4.4	6.5	5.6	6.6	4.4	6.2	6.8	7	4.3	6.0	6.6	6.6

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
4.5	5.5	7.4	4.2	4.3	5.1	7.2	4.4	4.2	5.3	7.2	4.1	4.4	5.5	7.2	5.1
4.6	7.4	7.8	7.2	4.4	7.1	7.7	7.1	4.4	7	7.5	7	4.4	7	7.5	7.5
4.2	5.8	7.3	4.7	4.2	5.7	7.1	4.6	4.2	5.5	6.9	4.4	4.2	5.6	7.1	5
4.6	7.4	7.8	7.2	4.4	7.1	7.7	7.1	4.4	7.0	7.5	7	4.4	7	7.5	7.5
4.5	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7.5	7.2	6.8	4.4	7.3	7.2	7.6
4.6	7.4	7.8	7.2	4.4	7.1	7.7	7.1	4.4	7.2	7.5	7	4.4	7	7.5	7.5
4.5	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7.3	7.2	6.8	4.4	7.3	7.2	7.6
4.5	6.5	6.8	7.2	4.4	6.3	6.5	7.1	4.4	6.1	6.3	7	4.4	6.1	6.6	7.2
4.7	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7.3	7.2	6.8	4.4	7.3	7.2	7.6
4.2	5.6	6.1	7.1	4.2	5.6	6.1	7.1	4.2	5.5	6.1	7	4.2	5.5	6.1	7
4.5	6.5	6.8	7.2	4.4	6.3	6.5	7.1	4.4	6.1	6.3	7	4.4	6.1	6.6	7.2
4.6	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7.3	7.2	6.8	4.4	7.3	7.2	7.6
7.2	4.4	7.3	7.2	6.8	4.4	7.3	7.2	7.6	6.5	6.1	6.8	4	6.8	6.4	7
5.0	7.2	8.4	7.8	4.8	7.1	8.1	7.5	4.8	7	8	7.2	4.8	7	8.2	7.6
4.8	6.8	8	7.1	4.7	6.8	7.6	7.1	4.6	6.8	7.4	7	4.6	6.8	7.6	7.4
4.4	6.6	6.7	7.4	4.4	6.6	6.5	7	4.4	6.5	6.5	6.8	4.4	6.5	7	6.8
4.8	6.6	6.8	7.4	4.8	6.6	6.8	7.4	4.8	6.6	6.6	7.1	4.8	6.6	6.6	6.8
4.2	5.5	7.0	5.2	4.2	5.5	6.4	5.1	4.2	5.4	6.3	5.0	4.2	5.4	6.3	5.6
3.3	4.9	6	6.1	3.3	4.9	5.9	5.8	3.3	4.9	5.5	5.6	3.3	4.9	5.6	5.8
4.6	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7.3	7.2	6.8	4.4	7.3	7.2	7.6
4.6	5.9	6.6	6.6	4.5	5.3	6.4	6.3	4.5	5.8	6.4	6.3	4.5	5.8	6.8	6.6
4.4	5.8	6.4	6.3	4.4	5.9	6.8	6.6	4.6	5.9	6.8	6.6	4.4	5.9	6.1	5.4
4.6	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7.3	7.2	6.8	4.4	7.3	7.2	7.6
4.2	5.0	6.6	6.1	4.2	4.6	5.6	5.9	4.2	5	5.5	5.5	4.2	5	5.5	5.1
4.2	5.6	6.1	7.1	4.2	5.6	6.1	7.1	4.2	5.5	6.1	7	4.2	5.5	6.1	7

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
4.4	5.7	7.6	4.3	4.4	5.5	7.4	4.3	4.4	5.4	7.2	4.2	4.4	5.4	7.1	5
4.8	7.4	8.6	7.2	4.7	7.3	8.5	7	4.6	7.2	8.4	7.	4.6	7.4	8.4	7.5
4.2	5.8	7.3	4.7	4.2	5.7	7.1	4.6	4.2	5.5	6.9	4.4	4.2	5.6	7.1	5
4.6	5.1	7.6	4.4	4.3	5.6	7.6	4.4	4.2	4.8	7.0	4.4	4	4.8	6.5	5.8
4.5	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7.3	7.2	6.8	4.4	7.3	7.2	7.6
4.6	7.4	7.8	7.2	4.4	7.1	7.7	7.1	4.4	7.2	7.5	7.1	4.4	7	7.5	7.5
4.5	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7.0	7.2	6.8	4.4	7.3	7.2	7.6
4.8	7.4	8	7.8	4.7	7.2	7.8	7.5	4.4	7.3	7.1	7.2	4.4	7.3	7.5	7.6
4.6	6.2	6.2	7	4.6	6.2	6.2	7	4.4	6	6	6.9	4.4	6	6.4	7.2
4.2	5.6	6.1	7.1	4.2	5.6	6.1	7.1	4.2	5.5	6.1	7.2	4.2	5.5	6.1	7
4.5	6.5	6.8	7.2	4.4	6.3	6.5	7.1	4.4	6.1	6.3	7.3	4.4	6.1	6.6	7.2
4.2	5.6	6	7.2	4.2	5.6	6	7.2	4.2	5.4	6.2	7.4	4.2	5.4	6	7
4.0	5.8	6.2	7	4	6.3	6.2	7	4	6.5	6.1	6.8	4	6.8	6.4	7
5.0	7.2	8.4	7.8	4.8	7.1	8.1	7.5	4.8	7	8	7.2	4.8	7	8.2	7.6
4.8	6.8	8	7.1	4.7	6.8	7.6	7.1	4.6	6.8	7.4	7	4.6	6.8	7.6	7.4
4.4	6.6	6.7	7.4	4.4	6.6	6.5	7	4.4	6.5	6.5	6.8	4.4	6.5	7	6.8
4.8	6.6	6.8	7.4	4.8	6.6	6.8	7.4	4.8	6.6	6.6	7.1	4.8	6.6	6.6	6.8
4.2	5.5	7.0	5.2	4.2	5.5	6.4	5.1	4.2	5.4	6.3	5.0	4.2	5.4	6.3	5.6
3.3	4.9	6	6.1	3.3	4.9	5.9	5.8	3.3	4.9	5.5	5.6	3.3	4.9	5.6	5.8
4	4.8	5.2	5.2	4	4.3	5.2	5.2	4	4.8	5.2	5.2	4	4.8	5.2	5.2
4.6	5.9	6.6	6.6	4.5	5.3	6.4	6.3	4.5	5.8	6.4	6.3	4.5	5.8	6.8	6.6
4.4	5.8	6.4	6.3	4.4	5.9	6.8	6.6	4.6	5.9	6.8	6.6	4.4	5.9	6.1	5.4
5.1	7.1	8	5.7	4.6	5.9	6.9	6.8	4.6	5.9	6.7	6.6	4.6	6.2	6.8	7
4.2	5.0	6.6	6.1	4.2	4.6	5.6	5.9	4.2	5	5.5	5.5	4.2	5	5.5	5.1
4.4	6.1	4.7	4.8	4.4	6.5	5.6	6.6	4.4	6.2	6.8	7	4.3	6.0	6.6	6.6



INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
4.4	5.7	7.6	4.3	4.4	5.5	7.4	4.3	4.4	5.4	7.2	4.2	4.4	5.4	7.1	5
4.8	7.4	8.6	7.2	4.7	7.3	8.5	7	4.6	7.2	8.4	7.	4.6	7.4	8.4	7.5
4.2	5.8	7.3	4.7	4.2	5.7	7.1	4.6	4.2	5.5	6.9	4.4	4.2	5.6	7.1	5
4.6	5.1	7.6	4.4	4.3	5.6	7.6	4.4	4.2	4.8	7.0	4.4	4	4.8	6.5	5.8
4.5	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7.3	7.2	6.8	4.4	7.3	7.2	7.6
4.6	7.4	7.8	7.2	4.4	7.1	7.7	7.1	4.4	7.2	7.5	7.1	4.4	7	7.5	7.5
4.5	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7.0	7.2	6.8	4.4	7.3	7.2	7.6
4.8	7.4	8	7.8	4.7	7.2	7.8	7.5	4.4	7.3	7.1	7.2	4.4	7.3	7.5	7.6
4.6	6.2	6.2	7	4.6	6.2	6.2	7	4.4	6	6	6.9	4.4	6	6.4	7.2
4.2	5.6	6.1	7.1	4.2	5.6	6.1	7.1	4.2	5.5	6.1	7.2	4.2	5.5	6.1	7
4.5	6.5	6.8	7.2	4.4	6.3	6.5	7.1	4.4	6.1	6.3	7.3	4.4	6.1	6.6	7.2
4.2	5.6	6	7.2	4.2	5.6	6	7.2	4.2	5.4	6.2	7.4	4.2	5.4	6	7
4.0	5.8	6.2	7	4	6.3	6.2	7	4	6.5	6.1	6.8	4	6.8	6.4	7
5.0	7.2	8.4	7.8	4.8	7.1	8.1	7.5	4.8	7	8	7.2	4.8	7	8.2	7.6
4.8	6.8	8	7.1	4.7	6.8	7.6	7.1	4.6	6.8	7.4	7	4.6	6.8	7.6	7.4
4.4	6.6	6.7	7.4	4.4	6.6	6.5	7	4.4	6.5	6.5	6.8	4.4	6.5	7	6.8
4.8	6.6	6.8	7.4	4.8	6.6	6.8	7.4	4.8	6.6	6.6	7.1	4.8	6.6	6.6	6.8
4.2	5.5	7.0	5.2	4.2	5.5	6.4	5.1	4.2	5.4	6.3	5.0	4.2	5.4	6.3	5.6
3.3	4.9	6	6.1	3.3	4.9	5.9	5.8	3.3	4.9	5.5	5.6	3.3	4.9	5.6	5.8
4	4.8	5.2	5.2	4	4.3	5.2	5.2	4	4.8	5.2	5.2	4	4.8	5.2	5.2
4.6	5.9	6.6	6.6	4.5	5.3	6.4	6.3	4.5	5.8	6.4	6.3	4.5	5.8	6.8	6.6
4.4	5.8	6.4	6.3	4.4	5.9	6.8	6.6	4.6	5.9	6.8	6.6	4.4	5.9	6.1	5.4
5.1	7.1	8	5.7	4.6	5.9	6.9	6.8	4.6	5.9	6.7	6.6	4.6	6.2	6.8	7
4.2	5.0	6.6	6.1	4.2	4.6	5.6	5.9	4.2	5	5.5	5.5	4.2	5	5.5	5.1
4.4	6.1	4.7	4.8	4.4	6.5	5.6	6.6	4.4	6.2	6.8	7	4.3	6.0	6.6	6.6

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
4.6	5.1	7.2	4.4	4.2	5.2	7.4	4.2	4.3	5.1	7.5	4.3	4.1	5.2	7.0	5.1
4.6	7.4	7.8	7.2	4.4	7.1	7.7	7.1	4.4	7.3	7.5	7	4.4	7	7.5	7.5
4.2	5.8	7.3	4.7	4.2	5.7	7.1	4.6	4.2	5.5	6.9	4.4	4.2	5.6	7.1	5
4.6	7.4	7.8	7.2	4.4	7.1	7.7	7.1	4.4	7.3	7.5	7	4.4	7	7.5	7.5
4.8	7.4	7.8	7.2	4.4	7.1	7.7	7.1	4.4	7.3	7.5	7	4.4	7	7.5	7.5
4.2	5.8	7.3	4.7	4.2	5.7	7.1	4.6	4.2	5.5	6.9	4.4	4.2	5.6	7.1	5
4.5	7.5	7.4	7.6	4.4	7.3	7.1	7.2	4.4	7	7.2	6.8	4.4	7.3	7.2	7.6
4.8	7.4	8	7.8	4.7	7.2	7.8	7.5	4.4	7.3	7.1	7.2	4.4	7.3	7.5	7.6
4.6	6.2	6.2	7	4.6	6.2	6.2	7	4.4	6	6	6.9	4.4	6	6.4	7.2
4.6	7.4	7.8	7.2	4.4	7.1	7.7	7.1	4.4	7.3	7.5	7	4.4	7	7.5	7.5
4.6	6.2	6.2	7	4.6	6.2	6.2	7	4.4	6	6	6.9	4.4	6	6.4	7.2
4.2	5.8	7.3	4.7	4.2	5.7	7.1	4.6	4.2	5.5	6.9	4.4	4.2	5.6	7.1	5
4.0	5.8	6.2	7	4	6.3	6.2	7	4	6.5	6.1	6.8	4	6.8	6.4	7
4.0	7.2	8.4	7.8	4.8	7.1	8.1	7.5	4.8	7	8	7.2	4.8	7	8.2	7.6
4.8	6.8	8	7.1	4.7	6.8	7.6	7.1	4.6	6.8	7.4	7	4.6	6.8	7.6	7.4
4.4	6.6	6.7	7.4	4.4	6.6	6.5	7	4.4	6.5	6.5	6.8	4.4	6.5	7	6.8
4.6	6.2	6.2	7	4.6	6.2	6.2	7	4.4	6	6	6.9	4.4	6	6.4	7.2
4.2	5.8	7.3	4.7	4.2	5.7	7.1	4.6	4.2	5.5	6.9	4.4	4.2	5.6	7.1	5
4.0	5.8	6.2	7	4	6.3	6.2	7	4	6.5	6.1	6.8	4.3	6.8	6.4	7
4.1	4.8	5.2	5.2	4	4.3	5.2	5.2	4	4.8	5.2	5.2	4.4	4.8	5.2	5.2
4.5	5.9	6.6	6.6	4.5	5.3	6.4	6.3	4.5	5.8	6.4	6.3	4.5	5.8	6.8	6.6
4.4	5.8	6.4	6.3	4.4	5.9	6.8	6.6	4.6	5.9	6.8	6.6	4.4	5.9	6.1	5.4
4.6	6.2	6.2	7	4.6	6.2	6.2	7	4.4	6	6	6.9	4.4	6.1	6.4	7.2
4.2	5.8	7.3	4.7	4.2	5.7	7.1	4.6	4.2	5.5	6.9	4.4	4.2	5.6	7.1	5.3
4.0	5.8	6.2	7.2	4.3	6.3	6.2	7.2	4.2	6.5	6.1	6.8	4.3	6.8	6.4	7.2

CONTROL GROUP OF SUMMER

HARVARD STEP TEST PULSE COUNT (NO.)

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
71	65	62	73	67	57	71	65	61	73	65	64
74	63	60	74	68	58	72	66	62	72	66	62
80	72	65	80	72	65	78	73	69	76	72	68
72	65	60	70	64	60	72	63	59	74	64	62
70	65	58	74	63	60	72	65	60	70	62	57
80	72	65	79	72	69	76	69	66	8	73	69
70	66	56	70	64	55	68	64	60	70	61	58
72	65	60	70	64	60	72	63	59	74	64	62
70	65	58	74	63	60	72	65	60	70	62	57
80	72	65	79	72	69	76	69	66	8	73	69
70	66	56	70	64	55	68	64	60	70	61	58
80	72	65	80	72	65	78	73	69	76	72	68
72	65	60	70	64	60	72	63	59	74	64	62
70	65	58	74	63	60	72	65	60	70	62	57
80	72	65	79	72	69	76	69	66	8	73	69
70	66	56	70	64	55	68	64	60	70	61	58
72	65	60	70	64	60	72	63	59	74	64	62
72	69	65	72	66	59	74	68	63	74	68	64
76	64	62	72	66	64	72	65	60	74	66	60
72	68	65	72	66	59	76	69	66	74	69	65
73	65	59	72	68	62	74	68	58	70	65	59
76	72	68	72	64	58	78	69	64	76	69	66
72	69	65	72	66	59	74	68	63	74	68	64
76	64	62	72	66	64	72	65	60	74	66	60
72	68	65	72	66	59	76	69	66	74	69	65

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
71	63	62	73	65	58	71	65	61	71	65	60
73	64	61	73	65	60	71	64	58	70	64	58
68	64	60	72	65	52	70	62	57	70	67	55
72	63	59	68	64	60	70	67	55	72	65	60
74	68	63	74	69	65	74	66	62	74	66	62
74	63	60	74	68	58	72	66	62	72	66	62
80	72	65	80	72	65	78	73	69	76	72	68
72	65	60	70	64	60	72	63	59	74	64	62
70	65	58	74	63	60	72	65	60	70	62	57
80	72	65	79	72	69	76	69	66	8	73	69
70	66	56	70	64	55	68	64	60	70	61	58
70	64	60	72	65	60	72	65	60	72	63	59
72	65	60	74	68	58	72	65	52	68	64	60
73	67	65	68	64	60	74	69	65	74	68	58
70	67	55	74	68	63	70	64	55	74	66	62
72	66	59	72	63	59	72	63	59	74	68	60
72	66	62	72	65	62	74	68	58	68	64	57
72	69	65	72	64	59	74	68	63	74	68	64
76	64	62	72	63	64	72	65	60	74	66	60
72	68	65	72	64	59	76	69	66	74	69	65
73	65	59	72	68	62	74	68	58	70	65	59
76	72	68	72	64	58	78	69	64	76	69	66
74	69	65	78	68	65	74	68	63	74	68	63
70	55	69	74	68	63	72	66	61	74	66	62
78	73	69	79	72	69	78	70	63	80	72	65

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
70	64	60	72	66	59	72	66	62	72	66	62
70	66	56	70	64	55	68	64	60	70	61	58
70	64	60	72	65	60	72	65	60	72	63	59
72	65	60	74	68	58	72	65	52	68	64	60
73	67	65	68	64	60	74	69	65	74	68	58
70	67	55	74	68	63	70	64	55	74	66	62
72	66	59	72	63	59	72	63	59	74	68	60
72	66	62	72	65	62	74	68	58	68	64	57
72	69	65	72	64	59	74	68	63	74	68	64
76	64	62	72	63	64	72	65	60	74	66	60
72	68	65	72	64	59	76	69	66	74	69	65
73	65	59	72	68	62	74	68	58	70	65	59
70	64	60	72	65	60	72	65	60	72	63	59
72	65	60	74	68	58	72	65	52	68	64	60
73	67	65	68	64	60	74	69	65	74	68	58
70	67	55	74	68	63	70	64	55	74	66	62
72	66	59	72	63	59	72	63	59	74	68	60
72	66	62	72	66	62	74	68	58	68	64	57
72	69	65	72	66	59	74	68	63	74	68	64
76	64	62	72	66	64	72	65	60	74	66	60
72	68	65	72	66	59	76	69	66	74	69	65
73	65	59	72	68	62	74	68	58	70	65	59
76	72	68	72	64	58	78	69	64	76	69	66
74	69	65	78	68	65	74	68	63	74	68	63
70	55	69	74	68	63	72	66	61	74	66	62

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
71	62	63	73	64	58	71	63	64	75	66	65
74	66	62	72	66	62	72	66	59	72	66	59
72	66	59	72	63	59	72	63	59	74	68	60
72	66	62	72	66	62	74	68	58	68	64	57
72	69	65	72	66	59	74	68	63	74	68	64
76	64	62	72	66	64	72	65	60	74	66	60
72	68	65	72	66	59	76	69	66	74	69	65
73	65	59	72	68	62	74	68	58	70	65	59
76	72	68	72	64	58	78	69	64	76	69	66
74	69	65	78	68	65	74	68	63	74	68	63
70	55	69	74	68	63	72	66	61	74	66	62
70	64	60	72	65	60	72	65	60	72	63	59
72	65	60	74	68	58	72	65	52	68	64	60
73	67	65	68	64	60	74	69	65	74	68	58
70	67	55	74	68	63	70	64	55	74	66	62
72	66	59	72	63	59	72	63	59	74	68	60
72	66	62	72	66	62	74	68	58	68	64	57
72	69	65	72	66	59	74	68	63	74	68	64
76	64	62	72	66	64	72	65	60	74	66	60
72	68	65	72	66	59	76	69	66	74	69	65
73	65	59	72	68	62	74	68	58	70	65	59
76	72	68	72	64	58	78	69	64	76	69	66
74	69	65	78	68	65	74	68	63	74	68	63
70	55	69	74	68	63	72	66	61	74	66	62
78	73	69	79	72	69	78	70	63	80	72	65

EXPERIMENTAL GROUP OF WINTER

MEASUREMENT OF SKINFOLD THICKNESS

(MM)

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
5.1	7.1	8.4	7.8	4.9	7	8.3	7.5	4.7	7	8	7.3	4.4	5.6	7.2	6.9
4.2	5.1	7.4	4.2	4.2	5.0	7.2	4.2	4.1	5	66	4.1	4.1	5	6.6	4.1
4.2	5.5	7	5.2	4.2	4.4	7	5.1	4.2	5.4	7.2	5.3	4.2	5.4	7.2	5.3
4	5	5.8	5	4	5.6	6.8	5.6	9.9	5	6.4	5.6	4	5.4	6.6	5.8
4.1	5.6	6.8	5.4	4.1	5.6	6.9	5.6	4	5.1	6.3	5.5	4	5.1	6.3	5.5
4.6	7.4	7.2	7.8	4.6	7.1	7.1	7.7	4.4	6.6	6.9	7.1	4.1	6.0	6.6	6.9
4.2	5.6	6	7.2	4.2	5.6	6.2	7.4	4.2	5.1	5.6	7	4.1	5.1	5.5	5.7
4.6	6.2	6.4	6.8	4.6	6.2	6.5	6.9	4.4	5.7	6	6.3	4.3	5.6	5.6	6.1
4.6	7.3	7.3	7.8	4.6	7.2	7	7.6	4.5	6	6.4	6.9	4.2	5.5	6	6.2
4.2	5.5	6.1	7.2	4.2	5.6	6.1	7.0	4.2	5.5	6	6.9	4.1	5.5	5.6	5.1
4.8	7.1	8.3	7.9	4.8	7	8	7.9	4.6	6.8	7.8	7.3	4.2	5.5	6	6.9
4.4	6.7	6.7	7.3	4.4	6.6	7	7.0	4.2	6	5.6	6.8	4.2	5.1	56	7
4.1	6.5	6.6	7.1	4.1	6.5	6.1	6.8	4.1	6.5	6.5	7	4.2	6	5.6	6.8
4.6	7.4	7.2	7.8	4.3	7.1	7	7.36	4.2	6.5	6.2	7	4.2	5.2	5.6	6.7
4.6	7.3	8.36	7.9	4.4	7	8.3	7.4	4.2	6	6.5	7.1	4.2	5.2	6	6.7
4.8	6.6	6.8	7.4	4.6	6.6	6.6	7.2	4.4	6.1	6	6.9	4.2	5.2	6.3	6.4
4.5	6.5	6.8	7.2	4.5	6.5	6.8	6.9	4.4	6	6.1	6.8	4.1	5.2	5.9	6.1
4	4.8	5.2	5.2	4	4.8	5.2	5.2	4	4.8	5.2	5.2	4.0	4.8	5.2	5.2
4.4	5.7	7.6	4.3	4.4	5.7	7.1	4.3	4.3	5.1	6.9	4.3	4.3	5.1	6.9	4.3
4.1	4.9	6	5.2	4.1	4.9	6	52	4.1	4.8	5.6	5	4.1	4.8	5.6	4.3
4.3	7	6.7	7.3	4.2	6.6	6.5	2.5	4.2	5.2	6.4	6.6	4.2	5.4	6	6.1
4.4	6.1	6.0	6.6	4.4	5.8	5.9	6.2	4.4	5.8	5.9	6.2	4.4	5.8	6.4	6.4
4.5	7.4	7.4	7.6	4.8	7.4	7.4	7.6	4.4	6.8	7	7.1	4.6	5.1	5.4	5.8
4.5	6.3	6.4	6.8	4.4	6	6.0	6.4	4.4	5.3	5.6	6	4.1	5.2	5.6	4.9
4.1	5.2	6.9	4.9	4.2	5.2	6.9	5	4.2	5.2	5.9	5.0	4.3	5.3	5.7	5.7

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
5.2	7.2	8.1	7.7	4.8	7.1	8.2	7.4	4.6	7.2	8.1	7.3	4.5	5.7	7.1	6.3
4.8	6.6	6.8	7.4	4.6	6.6	6.6	7.2	4.4	6.1	6	6.9	4.2	5.2	6.3	6.4
4.5	6.5	6.8	7.2	4.5	6.5	6.8	6.9	4.4	6	6.1	6.8	4.1	5.2	5.9	6.1
4	4.8	5.2	5.2	4	4.8	5.2	5.2	4	4.8	5.2	5.2	4.0	4.8	5.2	5.2
4.4	5.7	7.6	4.3	4.4	5.7	7.1	4.3	4.3	5.1	6.9	4.3	4.3	5.1	6.9	4.3
4.1	4.9	6	5.2	4.1	4.9	6	52	4.1	4.8	5.6	5	4.1	4.8	5.6	4.3
4.3	7	6.7	7.3	4.2	6.6	6.5	2.5	4.2	5.2	6.4	6.6	4.2	5.4	6	6.1
4.4	6.1	6.0	6.6	4.4	5.8	5.9	6.2	4.4	5.8	5.9	6.2	4.4	5.8	6.4	6.4
4.5	7.4	7.4	7.6	4.8	7.4	7.4	7.6	4.4	6.8	7	7.1	4.6	5.1	5.4	5.8
4.5	6.3	6.4	6.8	4.4	6	6.0	6.4	4.4	5.3	5.6	6	4.1	5.2	5.6	4.9
4.1	5.2	6.9	4.9	4.2	5.2	6.9	5	4.2	5.2	5.9	5.0	4.3	5.3	5.7	5.7
4.4	6.7	6.7	7.3	4.4	6.6	7	7.0	4.2	6	5.6	6.8	4.2	5.1	56	7
4.1	6.5	6.6	7.1	4.1	6.5	6.1	6.8	4.1	6.5	6.5	7	4.2	6	5.6	6.8
4.6	7.4	7.2	7.8	4.3	7.1	7	7.36	4.2	6.5	6.2	7	4.2	5.2	5.6	6.7
4.6	7.3	8.36	7.9	4.4	7	8.3	7.4	4.2	6	6.5	7.1	4.2	5.2	6	6.7
4.8	6.6	6.8	7.4	4.6	6.6	6.6	7.2	4.4	6.1	6	6.9	4.2	5.2	6.3	6.4
4.5	6.5	6.8	7.2	4.5	6.5	6.8	6.9	4.4	6	6.1	6.8	4.1	5.2	5.9	6.1
	4.8	5.2	5.2	4	4.8	5.2	5.2	4	4.8	5.2	5.2	4.0	4.8	5.2	5.2
4.4	5.7	7.6	4.3	4.4	5.7	7.1	4.3	4.3	5.1	6.9	4.3	4.3	5.1	6.9	4.3
4.5	7.4	7.4	7.6	4.8	7.4	7.4	7.6	4.4	6.8	7	7.1	4.6	5.1	5.4	5.8
4.5	6.3	6.4	6.8	4.4	6	6.0	6.4	4.4	5.3	5.6	6	4.1	5.2	5.6	4.9
4.1	5.2	6.9	4.9	4.2	5.2	6.9	5	4.2	5.2	5.9	5.0	4.3	5.3	5.7	5.7
4.4	6.7	6.7	7.3	4.4	6.6	7	7.0	4.2	6	5.6	6.8	4.2	5.1	56	7
4.1	6.5	6.6	7.1	4.1	6.5	6.1	6.8	4.1	6.5	6.5	7	4.2	6	5.6	6.8
4.6	7.4	7.2	7.8	4.3	7.1	7	7.36	4.2	6.5	6.2	7	4.2	5.2	5.6	6.7

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
5.2	7.0	8.1	7.4	4.6	7.2	8.1	7.2	4.4	7.2	8.3	7.4	4.5	5.1	7.3	6.8
4.5	6.3	6.4	6.8	4.4	6	6.0	6.4	4.4	5.3	5.6	6	4.1	5.2	5.6	4.9
4.1	5.2	6.9	4.9	4.2	5.2	6.9	5	4.2	5.2	5.9	5.0	4.3	5.3	5.7	5.7
4.4	6.7	6.7	7.3	4.4	6.6	7	7.0	4.2	6	5.6	6.8	4.2	5.1	56	7
4.1	6.5	6.6	7.1	4.1	6.5	6.1	6.8	4.1	6.5	6.5	7	4.2	6	5.6	6.8
4.6	7.4	7.2	7.8	4.3	7.1	7	7.36	4.2	6.5	6.2	7	4.2	5.2	5.6	6.7
4.6	7.3	8.36	7.9	4.4	7	8.3	7.4	4.2	6	6.5	7.1	4.2	5.2	6	6.7
4.8	6.6	6.8	7.4	4.6	6.6	6.6	7.2	4.4	6.1	6	6.9	4.2	5.2	6.3	6.4
4.5	6.5	6.8	7.2	4.5	6.5	6.8	6.9	4.4	6	6.1	6.8	4.1	5.2	5.9	6.1
	4.8	5.2	5.2	4	4.8	5.2	5.2	4	4.8	5.2	5.2	4.0	4.8	5.2	5.2
4.4	5.7	7.6	4.3	4.4	5.7	7.1	4.3	4.3	5.1	6.9	4.3	4.3	5.1	6.9	4.3
4.2	5.5	6.1	7.2	4.2	5.6	6.1	7.0	4.2	5.5	6	6.9	4.1	5.5	5.6	5.1
4.8	7.1	8.3	7.9	4.8	7	8	7.9	4.6	6.8	7.8	7.3	4.2	5.5	6	6.9
4.4	6.7	6.7	7.3	4.4	6.6	7	7.0	4.2	6	5.6	6.8	4.2	5.1	56	7
4.1	6.5	6.6	7.1	4.1	6.5	6.1	6.8	4.1	6.5	6.5	7	4.2	6	5.6	6.8
4.6	7.4	7.2	7.8	4.3	7.1	7	7.36	4.2	6.5	6.2	7	4.2	5.2	5.6	6.7
4.6	7.3	8.36	7.9	4.4	7	8.3	7.4	4.2	6	6.5	7.1	4.2	5.2	6	6.7
4.8	6.6	6.8	7.4	4.6	6.6	6.6	7.2	4.4	6.1	6	6.9	4.2	5.2	6.3	6.4
4.5	6.5	6.8	7.2	4.5	6.5	6.8	6.9	4.4	6	6.1	6.8	4.1	5.2	5.9	6.1
	4.8	5.2	5.2	4	4.8	5.2	5.2	4	4.8	5.2	5.2	4.0	4.8	5.2	5.2
4.4	5.7	7.6	4.3	4.4	5.7	7.1	4.3	4.3	5.1	6.9	4.3	4.3	5.1	6.9	4.3
4.1	4.9	6	5.2	4.1	4.9	6	52	4.1	4.8	5.6	5	4.1	4.8	5.6	4.3
4.3	7	6.7	7.3	4.2	6.6	6.5	2.5	4.2	5.2	6.4	6.6	4.2	5.4	6	6.1
4.4	6.1	6.0	6.6	4.4	5.8	5.9	6.2	4.4	5.8	5.9	6.2	4.4	5.8	6.4	6.4
4.5	7.4	7.4	7.6	4.8	7.4	7.4	7.6	4.4	6.8	7	7.1	4.6	5.1	5.4	5.8

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
5.2	7.3	8.3	7.2	4.3	7.2	8.1	7.4	4.2	7.1	8.3	7.4	4.2	5.4	7.3	6.8
4.2	5.5	6.1	7.2	4.2	5.6	6.1	7.0	4.2	5.5	6	6.9	4.1	5.5	5.6	5.1
4.8	7.1	8.3	7.9	4.8	7	8	7.9	4.6	6.8	7.8	7.3	4.2	5.5	6	6.9
4.4	6.7	6.7	7.3	4.4	6.6	7	7.0	4.2	6	5.6	6.8	4.2	5.1	56	7
4.1	6.5	6.6	7.1	4.1	6.5	6.1	6.8	4.1	6.5	6.5	7	4.2	6	5.6	6.8
4.6	7.4	7.2	7.8	4.3	7.1	7	7.36	4.2	6.5	6.2	7	4.2	5.2	5.6	6.7
4.6	7.3	8.36	7.9	4.4	7	8.3	7.4	4.2	6	6.5	7.1	4.2	5.2	6	6.7
4.8	6.6	6.8	7.4	4.6	6.6	6.6	7.2	4.4	6.1	6	6.9	4.2	5.2	6.3	6.4
4.5	6.5	6.8	7.2	4.5	6.5	6.8	6.9	4.4	6	6.1	6.8	4.1	5.2	5.9	6.1
4.8	7.1	8.3	7.9	4.8	7	8	7.9	4.6	6.8	7.8	7.3	4.2	5.5	6	6.9
4.4	6.7	6.7	7.3	4.4	6.6	7	7.0	4.2	6	5.6	6.8	4.2	5.1	56	7
4.1	6.5	6.6	7.1	4.1	6.5	6.1	6.8	4.1	6.5	6.5	7	4.2	6	5.6	6.8
4.6	7.4	7.2	7.8	4.3	7.1	7	7.36	4.2	6.5	6.2	7	4.2	5.2	5.6	6.7
4.6	7.3	8.36	7.9	4.4	7	8.3	7.4	4.2	6	6.5	7.1	4.2	5.2	6	6.7
4.8	6.6	6.8	7.4	4.6	6.6	6.6	7.2	4.4	6.1	6	6.9	4.2	5.2	6.3	6.4
4.5	6.5	6.8	7.2	4.5	6.5	6.8	6.9	4.4	6	6.1	6.8	4.1	5.2	5.9	6.1
4	4.8	5.2	5.2	4	4.8	5.2	5.2	4	4.8	5.2	5.2	4.0	4.8	5.2	5.2
4.4	5.7	7.6	4.3	4.4	5.7	7.1	4.3	4.3	5.1	6.9	4.3	4.3	5.1	6.9	4.3
4.1	4.9	6	5.2	4.1	4.9	6	52	4.1	4.8	5.6	5	4.1	4.8	5.6	4.3
4.3	7	6.7	7.3	4.2	6.6	6.5	2.5	4.2	5.2	6.4	6.6	4.2	5.4	6	6.1
4.2	5.5	6.1	7.2	4.2	5.6	6.1	7.0	4.2	5.5	6	6.9	4.1	5.5	5.6	5.1
4.8	7.1	8.3	7.9	4.8	7	8	7.9	4.6	6.8	7.8	7.3	4.2	5.5	6	6.9
4.4	6.7	6.7	7.3	4.4	6.6	7	7.0	4.2	6	5.6	6.8	4.2	5.1	56	7
4.1	6.5	6.6	7.1	4.1	6.5	6.1	6.8	4.1	6.5	6.5	7	4.2	6	5.6	6.8
4.6	7.4	7.2	7.8	4.3	7.1	7	7.36	4.2	6.5	6.2	7	4.2	5.2	5.6	6.7

EXPERIMENTAL GROUP OF WINTER

HARVARD STEP TEST PULSE COUNT (NO.)

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
71	65	61	72	63	54	71	62	64	72	64	51
72	68	65	76	69	57	74	65	53	78	60	51
74	64	62	74	66	60	72	66	54	76	62	51
72	68	51	74	64	54	72	64	52	68	60	57
70	64	55	68	66	54	72	66	54	74	64	54
74	68	60	75	65	60	72	64	54	78	60	51
72	64	58	74	60	54	76	60	53	72	64	52
72	66	62	74	66	60	72	66	52	72	66	58
74	68	63	71	68	65	74	64	59	72	66	54
74	69	95	74	66	62	72	66	54	76	60	53
74	68	66	74	66	62	72	64	58	76	60	53
72	68	65	76	69	57	74	65	53	78	60	51
74	64	62	74	66	60	72	66	54	76	62	51
72	68	51	74	64	54	72	64	52	68	60	57
70	64	55	68	66	54	72	66	54	74	64	54
74	68	60	75	65	60	72	64	54	78	60	51
72	64	58	74	60	54	76	60	53	72	64	52
72	66	62	74	66	60	72	66	52	72	66	58
74	68	63	71	68	65	74	64	59	72	66	54
74	69	95	74	66	62	72	66	54	76	60	53
72	66	59	74	60	55	76	60	53	76	60	53
72	68	63	70	64	60	72	64	52	72	64	58
76	69	46	71	66	85	74	66	62	74	62	58
74	66	67	76	66	66	74	66	62	72	66	62
72	69	68	74	60	68	74	67	61	74	62	58

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
71	62	63	74	65	56	74	63	64	72	63	55
70	64	55	68	66	54	72	66	54	74	64	54
74	68	60	75	65	60	72	64	54	78	60	51
72	64	58	74	60	54	76	60	53	72	64	52
72	66	62	74	66	60	72	66	52	72	66	58
74	68	63	71	68	65	74	64	59	72	66	54
74	69	95	74	66	62	72	66	54	76	60	53
72	66	59	74	60	55	76	60	53	76	60	53
72	68	63	70	64	60	72	64	52	72	64	58
76	69	46	71	66	85	74	66	62	74	62	58
74	66	67	76	66	66	74	66	62	72	66	62
72	69	68	74	60	68	74	67	61	74	62	58
74	64	62	74	66	60	72	66	54	76	62	51
72	68	51	74	64	54	72	64	52	68	60	57
70	64	55	68	66	54	72	66	54	74	64	54
74	68	60	75	65	60	72	64	54	78	60	51
74	66	67	76	66	66	74	66	62	72	66	62
72	69	68	74	60	68	74	67	61	74	62	58
74	64	62	74	66	60	72	66	54	76	62	51
72	68	51	74	64	54	72	64	52	68	60	57
70	64	55	68	66	54	72	66	54	74	64	54
74	68	63	71	68	65	74	64	59	72	66	54
74	69	95	74	66	62	72	66	54	76	60	53
72	66	59	74	60	55	76	60	53	76	60	53
72	68	63	70	64	60	72	64	52	72	64	58

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
74	66	67	76	66	66	74	66	62	72	66	62
76	72	68	76	69	63	74	66	62	74	66	60
70	64	55	68	66	54	72	66	54	74	64	54
74	68	63	71	68	65	74	64	59	72	66	54
74	69	95	74	66	62	72	66	54	76	60	53
72	66	59	74	60	55	76	60	53	76	60	53
72	68	63	70	64	60	72	64	52	72	64	58
76	69	46	71	66	85	74	66	62	74	62	58
74	66	67	76	66	66	74	66	62	72	66	62
72	69	68	74	60	68	74	67	61	74	62	58
74	64	62	74	66	60	72	66	54	76	62	51
72	68	51	74	64	54	72	64	52	68	60	57
70	64	55	68	66	54	72	66	54	74	64	54
74	68	60	75	65	60	72	64	54	78	60	51
72	64	58	74	60	54	76	60	53	72	64	52
72	66	62	74	66	60	72	66	52	72	66	58
72	68	63	70	64	60	72	64	52	72	64	58
76	69	46	71	66	85	74	66	62	74	62	58
74	66	67	76	66	66	74	66	62	72	66	62
72	69	68	74	60	68	74	67	61	74	62	58
74	64	62	74	66	60	72	66	54	76	62	51
72	68	51	74	64	54	72	64	52	68	60	57
72	68	63	70	64	60	72	64	52	72	64	58
76	69	46	71	66	85	74	66	62	74	62	58
74	66	67	76	66	66	74	66	62	72	66	62

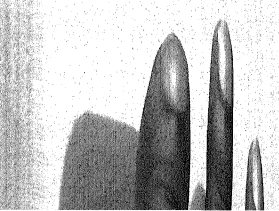
INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
76	69	46	71	66	85	74	66	62	74	62	58
72	68	63	70	64	60	72	64	52	72	64	58
76	69	46	71	66	85	74	66	62	74	62	58
74	66	67	76	66	66	74	66	62	72	66	62
72	69	68	74	60	68	74	67	61	74	62	58
74	64	62	74	66	60	72	66	54	76	62	51
72	68	51	74	64	54	72	64	52	68	60	57
76	69	46	71	66	85	74	66	62	74	62	58
74	66	67	76	66	66	74	66	62	72	66	62
72	69	68	74	60	68	74	67	61	74	62	58
72	68	63	70	64	60	72	64	52	72	64	58
76	69	46	71	66	85	74	66	62	74	62	58
74	66	67	76	66	66	74	66	62	72	66	62
72	69	68	74	60	68	74	67	61	74	62	58
74	64	62	74	66	60	72	66	54	76	62	51
72	68	51	74	64	54	72	64	52	68	60	57
76	69	46	71	66	85	74	66	62	74	62	58
74	66	67	76	66	66	74	66	62	72	66	62
72	69	68	74	60	68	74	67	61	74	62	58
72	66	62	74	62	58	76	60	53	68	60	57
74	68	66	74	66	62	72	64	58	76	60	53
72	68	65	76	69	57	74	65	53	78	60	51
74	64	62	74	66	60	72	66	54	76	62	51
72	68	51	74	64	54	72	64	52	68	60	57
70	64	55	68	66	54	72	66	54	74	64	54

EXPERIMENTAL GROUP OF SUMMER

MEASUREMENT OF SKINFOLD THICKNESS (MM)

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
4.8	6.6	6.8	7.4	4.2	6.6	6.2	7.0	4.1	6.4	5.8	6.6	3.9	5.8	6.2	4.2
4.2	5.5	7	5.2	4.2	4.8	7.2	4.8	4.1	4.6	6.6	4.4	3.9	4.3	4.4	4.5
4.2	4.8	5.6	5.2	4	4.8	5.1	5.3	3.9	4.5	4.8	4.9	.4	4.3	4.2	4.5
4	4.8	5.2	5.2	3.8	4.2	4.8	5.2	3.9	4.2	4.3	4.6	3.8	4.2	4.2	4.3
4.6	6.2	6.4	6.8	4.2	5.5	6.5	5.9	4.1	5.2	6.1	5.5	4.1	5.1	6.1	4.4
4.4	6.7	6.8	7.2	4.4	6.7	6.8	7.2	4.2	5.6	6.1	7.0	4.1	5.4	5.8	6
4.6	7.3	7.3	7.8	4.7	6.7	6.8	7.4	4.4	6.3	6.4	7	4.3	5.4	5.7	5.9
5	7.2	7.0	8.1	4.2	5.6	6.1	7.1	4.1	5.4	5.8	6.0	4.2	5.2	5.8	4.4
4.5	6.3	6.4	6.8	4	5	7.6	4.5	4.1	5.1	5.1	4.4	3.9	4.3	4.2	4.6
4.2	5.6	6	7.2	4.3	5.5	6.2	7.0	4.1	5.2	6.2	6.0	6.2	5	5.6	5
4.5	6.3	6.4	6.8	4	5	7.6	4.5	4.1	5.1	5.1	4.4	3.9	4.3	4.2	4.6
4.1	5.6	7	5.3	4.8	6.7	6.8	7.3	4.4	6.4	6.3	6.4	4.1	5.4	5.8	6.2
5.2	7.1	8	7.0	4.2	5.6	6	7.2	4.1	5.4	5.4	6.1	4.1	5.2	5.4	4.9
4.3	5.5	6.1	7.2	4.6	6.2	6.2	7	4.4	6.1	5.8	6.2	4.2	5.6	7.1	6
4.5	7.4	7.4	7.7	4.7	6.8	6.5	7.6	4.2	5.6	6	7.2	4	4.8	5.1	5.2
4.6	7.5	7.5	7.4	4	5.6	6.2	7.4	4	4.8	6	6.8	9.8	4.3	4.6	4.6
4	5	5.8	5	4	4.8	5.1	5.3	4	4.6	5	5	4.2	5.4	5.7	6.4
5.0	7.4	8	6.9	4.4	6.6	6.7	7.4	4.2	6.1	5.5	6.2	4	4.8	5	5.2
4.5	6.3	6.5	6.7	4.2	5.4	6	7.6	4	4.8	6	6.8	8.8	4.3	4.7	4.5
4.1	5.7	6.2	7.1	47.2	5.1	7.4	4.9	4	4.8	5.1	5.2	4.2	5.5	5.6	6.5
4.5	6.5	6.8	7.2	4.6	6.6	6.5	7.4	4.6	6.2	6.3	7.2	5.9	4.2	4.6	4.7
4.1	5.2	6.9	4.9	3.9	5.7	60	4.4	3.9	5.7	6	4.4	4.2	5.2	5.8	4.4
4.1	5.6	6.8	5.4	4	5.2	7	5.4	4	5.8	6	4.6	4.2	5.4	5.7	6.4
4.8	7.1	8.3	7.9	4.2	6.8	6.7	7.4	4.2	5.4	6	7.5	4.2	5.2	5.8	4.6
4.2	5.5	6.6	5.6	4.1	5.1	6.8	5.8	4.1	5	6.5	5.4	4	4.8	5	5.2

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
5.0	7.4	8	6.9	4.4	6.6	6.7	7.4	4.2	6.1	5.5	6.2	4	4.8	5	5.2
4.6	7.5	7.5	7.4	4	5.6	6.2	7.4	4	4.8	6	6.8	9.8	4.3	4.6	4.6
4	5	5.8	5	4	4.8	5.1	5.3	4	4.6	5	5	4.2	5.4	5.7	6.4
5.0	7.4	8	6.9	4.4	6.6	6.7	7.4	4.2	6.1	5.5	6.2	4	4.8	5	5.2
4.5	6.3	6.5	6.7	4.2	5.4	6	7.6	4	4.8	6	6.8	8.8	4.3	4.7	4.5
4.1	5.7	6.2	7.1	47.2	5.1	7.4	4.9	4	4.8	5.1	5.2	4.2	5.5	5.6	6.5
4.5	6.5	6.8	7.2	4.6	6.6	6.5	7.4	4.6	6.2	6.3	7.2	5.9	4.2	4.6	4.7
4.1	5.2	6.9	4.9	3.9	5.7	60	4.4	3.9	5.7	6	4.4	4.2	5.2	5.8	4.4
4.1	5.6	6.8	5.4	4	5.2	7	5.4	4	5.8	6	4.6	4.2	5.4	5.7	6.4
4.8	7.1	8.3	7.9	4.2	6.8	6.7	7.4	4.2	5.4	6	7.5	4.2	5.2	5.8	4.6
4.2	5.5	6.6	5.6	4.1	5.1	6.8	5.8	4.1	5	6.5	5.4	4	4.8	5	5.2
5.2	7.1	8	7.0	4.2	5.6	6	7.2	4.1	5.4	5.4	6.1	4.1	5.2	5.4	4.9
4.3	5.5	6.1	7.2	4.6	6.2	6.2	7	4.4	6.1	5.8	6.2	4.2	5.6	7.1	6
4.5	7.4	7.4	7.7	4.7	6.8	6.5	7.6	4.2	5.6	6	7.2	4	4.8	5.1	5.2
4.6	7.5	7.5	7.4	4	5.6	6.2	7.4	4	4.8	6	6.8	9.8	4.3	4.6	4.6
4	5	5.8	5	4	4.8	5.1	5.3	4	4.6	5	5	4.2	5.4	5.7	6.4
5.0	7.4	8	6.9	4.4	6.6	6.7	7.4	4.2	6.1	5.5	6.2	4	4.8	5	5.2
4.5	6.3	6.5	6.7	4.2	5.4	6	7.6	4	4.8	6	6.8	8.8	4.3	4.7	4.5
4.1	5.7	6.2	7.1	47.2	5.1	7.4	4.9	4	4.8	5.1	5.2	4.2	5.5	5.6	6.5
4.5	6.5	6.8	7.2	4.6	6.6	6.5	7.4	4.6	6.2	6.3	7.2	5.9	4.2	4.6	4.7
4.1	5.2	6.9	4.9	3.9	5.7	60	4.4	3.9	5.7	6	4.4	4.2	5.2	5.8	4.4
4.1	5.6	6.8	5.4	4	5.2	7	5.4	4	5.8	6	4.6	4.2	5.4	5.7	6.4
4.8	7.1	8.3	7.9	4.2	6.8	6.7	7.4	4.2	5.4	6	7.5	4.2	5.2	5.8	4.6
4.2	5.5	6.6	5.6	4.1	5.1	6.8	5.8	4.1	5	6.5	5.4	4	4.8	5	5.2
4.6	7.5	7.5	7.4	4	5.6	6.2	7.4	4	4.8	6	6.8	9.8	4.3	4.6	4.6



INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
Bi ceps	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
4.5	6.3	6.5	6.7	4.2	5.4	6	7.6	4	4.8	6	6.8	8.8	4.3	4.7	4.5
4.1	5	5.8	5	4	4.8	5.1	5.3	4	4.6	5	5	4.2	5.4	5.7	6.4
5.0	7.4	8	6.9	4.4	6.6	6.7	7.4	4.2	6.1	5.5	6.2	4	4.8	5	5.2
4.5	6.3	6.5	6.7	4.2	5.4	6	7.6	4	4.8	6	6.8	8.8	4.3	4.7	4.5
5.2	7.2	7.0	8.1	4.2	5.6	6.1	7.1	4.1	5.4	5.8	6.0	4.2	5.2	5.8	4.4
4.5	6.3	6.4	6.8	4	5	7.6	4.5	4.1	5.1	5.1	4.4	3.9	4.3	4.2	4.6
4.2	5.6	6	7.2	4.3	5.5	6.2	7.0	4.1	5.2	6.2	6.0	6.2	5	5.6	5
4.5	6.3	6.4	6.8	4	5	7.6	4.5	4.1	5.1	5.1	4.4	3.9	4.3	4.2	4.6
4.1	5.6	7	5.3	4.8	6.7	6.8	7.3	4.4	6.4	6.3	6.4	4.1	5.4	5.8	6.2
5.2	7.1	8	7.0	4.2	5.6	6	7.2	4.1	5.4	5.4	6.1	4.1	5.2	5.4	4.9
4.3	5.5	6.1	7.2	4.6	6.2	6.2	7	4.4	6.1	5.8	6.2	4.2	5.6	7.1	6
4.5	7.4	7.4	7.7	4.7	6.8	6.5	7.6	4.2	5.6	6	7.2	4	4.8	5.1	5.2
4.6	7.5	7.5	7.4	4	5.6	6.2	7.4	4	4.8	6	6.8	9.8	4.3	4.6	4.6
4	5	5.8	5	4	4.8	5.1	5.3	4	4.6	5	5	4.2	5.4	5.7	6.4
5.0	7.4	8	6.9	4.4	6.6	6.7	7.4	4.2	6.1	5.5	6.2	4	4.8	5	5.2
4.5	6.3	6.5	6.7	4.2	5.4	6	7.6	4	4.8	6	6.8	8.8	4.3	4.7	4.5
4.1	5.7	6.2	7.1	47.2	5.1	7.4	4.9	4	4.8	5.1	5.2	4.2	5.5	5.6	6.5
4.5	6.3	6.4	6.8	4	5	7.6	4.5	4.1	5.1	5.1	4.4	3.9	4.3	4.2	4.6
4.1	5.6	7	5.3	4.8	6.7	6.8	7.3	4.4	6.4	6.3	6.4	4.1	5.4	5.8	6.2
5.2	7.1	8	7.0	4.2	5.6	6	7.2	4.1	5.4	5.4	6.1	4.1	5.2	5.4	4.9
4.3	5.5	6.1	7.2	4.6	6.2	6.2	7	4.4	6.1	5.8	6.2	4.2	5.6	7.1	6
4.5	7.4	7.4	7.7	4.7	6.8	6.5	7.6	4.2	5.6	6	7.2	4	4.8	5.1	5.2
4.6	7.5	7.5	7.4	4	5.6	6.2	7.4	4	4.8	6	6.8	9.8	4.3	4.6	4.6
4	5	5.8	5	4	4.8	5.1	5.3	4	4.6	5	5	4.2	5.4	5.7	6.4
5.0	7.4	8	6.9	4.4	6.6	6.7	7.4	4.2	6.1	5.5	6.2	4	4.8	5	5.2

INITIAL TEST				SECOND TEST				THIRD TEST				FOURTH TEST			
s	Tri ceps	Sub Scapula	Supra Sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac	Bi ceps	Tri ceps	Sub scapula	Supra sliac
2	4.8	5.6	5.2	4	4.8	5.1	5.3	3.9	4.5	4.8	4.9	.4	4.3	4.2	4.5
6	6.2	6.4	6.8	4.2	5.5	6.5	5.9	4.1	5.2	6.1	5.5	4.1	5.1	6.1	4.4
1	5.7	6.2	7.1	47.2	5.1	7.4	4.9	4	4.8	5.1	5.2	4.2	5.5	5.6	6.5
2	4.8	5.6	5.2	4	4.8	5.1	5.3	3.9	4.5	4.8	4.9	.4	4.3	4.2	4.5
3	4.8	5.2	5.2	3.8	4.2	4.8	5.2	3.9	4.2	4.3	4.6	3.8	4.2	4.2	4.3
6	6.2	6.4	6.8	4.2	5.5	6.5	5.9	4.1	5.2	6.1	5.5	4.1	5.1	6.1	4.4
1	5.7	6.2	7.1	47.2	5.1	7.4	4.9	4	4.8	5.1	5.2	4.2	5.5	5.6	6.5
5	6.3	6.4	6.8	4	5	7.6	4.5	4.1	5.1	5.1	4.4	3.9	4.3	4.2	4.6
1	5.6	7	5.3	4.8	6.7	6.8	7.3	4.4	6.4	6.3	6.4	4.1	5.4	5.8	6.2
2	7.1	8	7.0	4.2	5.6	6	7.2	4.1	5.4	5.4	6.1	4.1	5.2	5.4	4.9
3	5.5	6.1	7.2	4.6	6.2	6.2	7	4.4	6.1	5.8	6.2	4.2	5.6	7.1	6
5	7.4	7.4	7.7	4.7	6.8	6.5	7.6	4.2	5.6	6	7.2	4	4.8	5.1	5.2
6	7.5	7.5	7.4	4	5.6	6.2	7.4	4	4.8	6	6.8	9.8	4.3	4.6	4.6
	5	5.8	5	4	4.8	5.1	5.3	4	4.6	5	5	4.2	5.4	5.7	6.4
0	7.4	8	6.9	4.4	6.6	6.7	7.4	4.2	6.1	5.5	6.2	4	4.8	5	5.2
5	6.3	6.5	6.7	4.2	5.4	6	7.6	4	4.8	6	6.8	8.8	4.3	4.7	4.5
1	5.7	6.2	7.1	47.2	5.1	7.4	4.9	4	4.8	5.1	5.2	4.2	5.5	5.6	6.5
5	7.4	7.4	7.7	4.7	6.8	6.5	7.6	4.2	5.6	6	7.2	4	4.8	5.1	5.2
6	7.5	7.5	7.4	4	5.6	6.2	7.4	4	4.8	6	6.8	9.8	4.3	4.6	4.6
2	5.3	5.8	5.1	4.4	4.8	5.1	5.3	4.3	4.6	5.6	5	4.2	5.4	5.7	6.4
0	7.4	8	6.9	4.4	6.6	6.7	7.4	4.2	6.1	5.5	6.2	4	4.8	5	5.2
5	6.3	6.5	6.7	4.2	5.4	6	7.6	4	4.8	6	6.8	8.8	4.3	4.7	4.5
1	5.7	6.2	7.1	47.2	5.1	7.4	4.9	4	4.8	5.1	5.2	4.2	5.5	5.6	6.5
5	6.5	6.8	7.2	4.6	6.6	6.5	7.4	4.6	6.2	6.3	7.2	5.9	4.2	4.6	4.7
1	5.2	6.9	4.9	3.9	5.7	60	4.4	3.9	5.7	6	4.4	4.2	5.2	5.8	4.4

EXPERIMENTAL GROUP OF SUMMER

HARVARD STEP TEST PULSE COUNT (NO.)

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
72	65	60	72	65	59	68	66	58	73	62	57
82	70	65	76	71	67	76	69	66	74	66	60
73	64	60	70	65	59	70	64	60	68	65	59
70	65	57	68	66	58	70	66	56	74	60	55
70	64	60	70	65	57	72	60	57	68	64	56
74	66	62	74	64	62	72	64	58	70	65	57
70	65	59	68	66	58	71	64	55	69	63	56
68	66	58	70	65	57	70	66	56	68	64	60
74	68	63	68	67	57	72	68	57	68	65	59
76	69	66	74	68	63	74	64	62	70	66	58
70	66	58	70	65	57	68	65	59	74	66	57
70	65	57	70	66	56	70	64	55	70	66	56
80	72	65	76	72	68	74	69	65	70	65	57
74	63	60	70	64	60	68	66	58	74	66	60
72	68	65	72	66	62	74	63	60	70	66	57
72	65	60	72	66	59	70	66	58	70	66	58
74	64	62	72	68	57	70	62	57	74	60	55
70	65	57	70	66	56	74	66	66	74	61	56
73	67	65	74	66	62	74	66	57	74	68	56
72	66	62	72	66	59	70	64	60	75	64	60
72	66	59	74	63	60	74	66	60	72	46	60
74	69	65	72	68	65	73	67	65	74	67	56
76	71	67	76	69	66	74	69	60	72	69	55
79	72	69	80	72	65	76	69	76	75	67	64
70	65	59	70	65	57	74	61	41	46	62	50

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
73	64	60	70	65	59	70	64	60	68	65	59
82	70	65	76	71	67	76	69	66	74	66	60
73	64	60	70	65	59	70	64	60	68	65	59
70	65	57	68	66	58	70	66	56	74	60	55
70	64	60	70	65	57	72	60	57	68	64	56
74	66	62	74	64	62	72	64	58	70	65	57
70	65	59	68	66	58	71	64	55	69	63	56
68	66	58	70	65	57	70	66	56	68	64	60
74	68	63	68	67	57	72	68	57	68	65	59
76	69	66	74	68	63	74	64	62	70	66	58
70	66	58	70	65	57	68	65	59	74	66	57
70	65	57	70	66	56	70	64	55	70	66	56
80	72	65	76	72	68	74	69	65	70	65	57
74	63	60	70	64	60	68	66	58	74	66	60
72	68	65	72	66	62	74	63	60	70	66	57
72	65	60	72	66	59	70	66	58	70	66	58
74	64	62	72	68	57	70	62	57	74	60	55
70	64	60	70	65	57	72	60	57	68	64	56
74	66	62	74	64	62	72	64	58	70	65	57
70	65	59	68	66	58	71	64	55	69	63	56
68	66	58	70	65	57	70	66	56	68	64	60
74	68	63	68	67	57	72	68	57	68	65	59
76	69	66	74	68	63	74	64	62	70	66	58
70	66	58	70	65	57	68	65	59	74	66	57
70	65	57	70	66	56	70	64	55	70	66	56

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
74	64	62	72	68	57	70	62	57	74	60	55
72	65	60	72	66	59	70	66	58	70	66	58
74	64	62	72	68	57	70	62	57	74	60	55
70	64	60	70	65	57	72	60	57	68	64	56
74	66	62	74	64	62	72	64	58	70	65	57
70	65	59	68	66	58	71	64	55	69	63	56
68	66	58	70	65	57	70	66	56	68	64	60
74	68	63	68	67	57	72	68	57	68	65	59
76	69	66	74	68	63	74	64	62	70	66	58
70	66	58	70	65	57	68	65	59	74	66	57
70	65	57	70	66	56	70	64	55	70	66	56
80	72	65	76	72	68	74	69	65	70	65	57
76	69	66	74	68	63	74	64	62	70	66	58
70	66	58	70	65	57	68	65	59	74	66	57
70	65	57	70	66	56	70	64	55	70	66	56
80	72	65	76	72	68	74	69	65	70	65	57
74	63	60	70	64	60	68	66	58	74	66	60
72	68	65	72	66	62	74	63	60	70	66	57
72	65	60	72	66	59	70	66	58	70	66	58
74	64	62	72	68	57	70	62	57	74	60	55
70	65	57	70	66	56	74	66	66	74	61	56
73	67	65	74	66	62	74	66	57	74	68	56
72	66	62	72	66	59	70	64	60	75	64	60
72	66	59	74	63	60	74	66	60	72	46	60
74	69	65	72	68	65	73	67	65	74	67	56

INITIAL TEST			SECOND TEST			THIRD TEST			FOURTH TEST		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
80	72	65	76	72	68	74	69	65	70	65	57
72	66	62	72	66	59	70	64	60	75	64	60
72	66	59	74	63	60	74	66	60	72	46	60
74	69	65	72	68	65	73	67	65	74	67	56
76	71	67	76	69	66	74	69	60	72	69	55
79	72	69	80	72	65	76	69	76	75	67	64
70	65	59	70	65	57	74	61	41	46	62	50
70	65	57	70	66	56	70	64	55	70	66	56
80	72	65	76	72	68	74	69	65	70	65	57
74	63	60	70	64	60	68	66	58	74	66	60
72	68	65	72	66	62	74	63	60	70	66	57
72	65	60	72	66	59	70	66	58	70	66	58
74	64	62	72	68	57	70	62	57	74	60	55
70	65	57	70	66	56	74	66	66	74	61	56
73	67	65	74	66	62	74	66	57	74	68	56
72	66	62	72	66	59	70	64	60	75	64	60
72	66	59	74	63	60	74	66	60	72	46	60
74	69	65	72	68	65	73	67	65	74	67	56
76	71	67	76	69	66	74	69	60	72	69	55
79	72	69	80	72	65	76	69	76	75	67	64
70	65	59	70	65	57	74	61	41	46	62	50
74	63	60	70	64	60	68	66	58	74	66	60
72	68	65	72	66	62	74	63	60	70	66	57
72	65	60	72	66	59	70	66	58	70	66	58
74	64	62	72	68	57	70	62	57	74	60	55

APPENDIX-B

ASSESSMENT OF BODY COMPOSITION

Percentage of fat corresponding to the total value of Skinfolds at four sites (Biceps, Triceps, sub-scapular and supra-iliac).

(Rounding off in the % of fat accounts of the difference between adjoining value not being uniform).

Total skinfold Thickness (MM)	Fat (Percentage of Body Weight) Boys.
15	9.0
20	12.5
25	15.5
30	17.5
35	19.5
40	21.5
45	23.0
50	24.0
55	25.5
60	26.5
65	27.5
70	28.5
75	29.5

J.V.G.A. Durnin & M.M. Rahaman, 'Percentage of Fat Corresponding to the total value of skinfolds' British Journal of Nutrition 21 (1967), 681.

(FORMULA) ONE WAY ANALYSIS OF VARIANCE

1st Step

$$C.F. = \frac{C^2}{N}$$

2nd Step

$$RSS = y_i^2$$

3rd Step

$$TSS = RSS - CF$$

4th Step

$$(SS)_b = \frac{(a)^2}{n} + \frac{(b)^2}{n} + \frac{(c)^2}{n} + \frac{(d)^2}{n} - CF$$

5th Step

$$(SS)_w = TSS - (SS)_b$$

ANOVA

Source of variance	Degree of freedom	Sum of square	Mean sum of square	F ratio
Between Groups	K-1	(SS)b	(SS)b / K – 1	$F = \frac{(MSS)_w}{(MSS)_w}$
Within Groups	N-K	$(SS)_w$	$(SS)_w$ / N – K	

Scheffe's 'S' Post Hoc Test

$$I = S\sqrt{(MS)_w\ Wg} \qquad S = \sqrt{(K-1)\ F.05(\ )}$$

$$= \sqrt{(K-1)\ F.05\ (\ )}\ \sqrt{\frac{1}{n} + \frac{1}{n}} \quad Wg = \frac{1}{n} + \frac{1}{n}$$

2nd Week Body Fat

(1) C.F. $= \frac{G^2}{N}$

$= \frac{(1456.5)^2}{100} = 21213.923$

(2) RSS = 21432.59

(3) TSS = RSS – CF = 218.667

(4) $(SS)_b = \frac{(365.6)^2}{25} + \frac{(349)^2}{25} + \frac{(373.6)^2}{25} + \frac{(368.3)^2}{25} - CF$

= 13.5254

(5) $(SS)_w$ = TSS – $(SS)_b$

= 205.142

ANOVA

Source of variance	d.f	SS	MSS	F
Between sets	K – 1 = 3	13.5254	4.508	2.109@
Within sets	N – K = 96	205.142	2.137	

Tab f .05 (3,96) = 2.704

@Not significant

4th Week Body Fat

(1) CF = 19830.272

(2) RSS = 20047.62

(3) TSS = 217.348

(4) $(SS)_b$ = 50.1336

(5) $(SS)_w$ = 167.2144

ANOVA

Between sets	4 – 1 = 3	50.1336	16.7112	9.593*
Within sets	96	167.2144	1.742	

Tab F.05 (3,96) = 2.704

*Significant at .05 level of confidence

Post Hoc Test

$$I = S\sqrt{(MS)_w\ Wg} \qquad S = \sqrt{(K-1).F\ .05\ (3.96)}$$

$$= \sqrt{1.742 \times \left(\frac{1}{25} \times \frac{1}{25}\right)} = \sqrt{3 \times 2.704}$$

$$= 2.848$$

$$= 1.742$$

$$\pm\ 1.062$$

PAIRED MEAN DIFFERENCE

Control (s)	Exp (s)	Control (w)	Exp. (w)	M.D.	C.D.
14.40	13.02			1.38*	1.062
14.40		14.95		.55	1.062
14.40			13.95	.45	1.062
	13.02	14.95		1.93*	1.062
	13.02		13.95	.93	1.062
		14.95	13.95	1.00	1.062

6th week Body Fat

(1) CF = 19162.865

(2) RSS = 19425.83

(3) TSS = 262.9651

(4) $(SS)_b$ = 115.1986

(5) $(SS)_w$ = 174.7665

ANOVA

S.V.	d.f.	SS	MSS	F	Obtained
Between groups	3	115.1986	38.333		
				24.908	2.704
Within groups	96	174.7665	1.539		

Post Hoc Test $_I$ = 2.848 × .351 = .0006

Paired Mean Difference

Control (s)	Exp. (s)	Control (w)	Exp (w)	MD	CD
14.62	12.26			2.36*	.999
14.62		15.01		.39	.999
14.62			13.48	1.14*	.999
	12.26	15.01		2.75*	.999
	12.26		13.48	1.22*	.999
		15.01	13.48	1.53*	.999

Endurance after 2nd week

(1) CF = 563550.49

(2) RSS = 564293

(3) TSS = 742.51

(4) $(SS)_b$ = 44.75

(5) $(SS)_w$ = 697.76

ANOVA

S.V.	d.f.	SS	MSS	F
Between groups	3	44.75	14.92	2.05@
within group	96	697.76	7.27	

N = 100

@Not significant F .05 (3, 96) = 2. 2.704

Endurance after 4th week

(1) CF = 576081

(2) RSS = 576826

(3) TSS = 745

(4) $(SS)_b$ = 185.48

(5) $(SS)_w$ = 559.52

ANOVA

S.V.	d.f.	SS	MSS	F
$(SS)_b$	3	185.48	61.83	10.6*
$(SS)_w$	96	559.5	5.83	

N = 100

*Significant at .05 level

$_I$ = 2.848 × .683 = 1.945

PAIRED MEAN DIFFERENCE

Control (s)	Exp (s)	Control (w)	Exp. (w)	M.D.	C.D.
74.84	76.2			1.36	1.945
74.84		74.56		.28	1.945
74.84			78	3.16*	1.945
	76.2	74.56		7.64	7.945
	76.2		78	1.80	1.945
		74.56	78	3.44*	1.945

*Significant at .05 level.

Endurance after 4th week

(1) CF = 583084.96

(2) RSS = 583624

(3) TSS = 539.04

(4) $(SS)_b$ = 344

(5) $(SS)_w$ = 194.8

ANOVA

S.V.	d.f.	SS	MSS	F
$(SS)_b$	3	344	114.67	
				56.52*
$(SS)_w$	96	194.8	2.029	

N = 100

*Significant at .05 level

I = 1.147

Post Hoc Test

Control (s)	Exp (s)	Control (w)	Exp. (w)	M.D.	C.D.
74.68	77.2			2.52*	1.147
74.68		74.48		.20	1.147
74.68			79	4.32*	1.147
	77.2	74.48		2.72*	1.147
	77.2		79	1.80*	1.147
		74.48	79	4.52*	1.147

*Significant at .05 level.